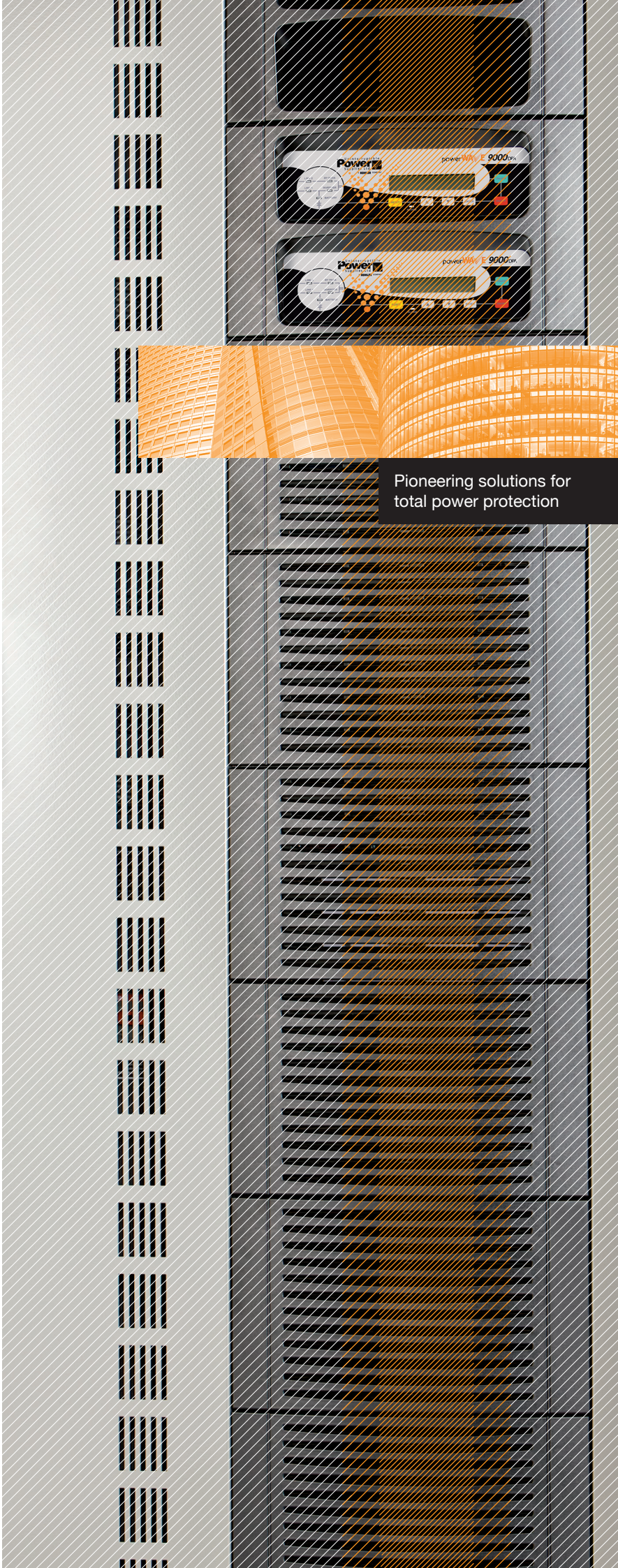
PowerWAVE 9000DPA

User Manual



Pioneering solutions for total power protection

Uninterruptible Power Supplies Ltd
A KOHLER COMPANY

Document Control

ISSUE	DATE	REVISION SUMMARY
471-02-00	06/08/2014	Manual revised and published as 471-02-00

Uninterruptible Power Supplies Ltd has taken every precaution to produce an accurate, complete and easy to understand manual and will therefore assume no responsibility nor liability for direct, indirect or accidental personal or material damage due to any misinterpretation of or accidental mistakes in this manual.

© 2005 Uninterruptible Power Supplies Ltd

This manual may not be copied nor reproduced without written permission of Uninterruptible Power Supplies Ltd.

Table of Contents

Safety **1**

1.1 Description of symbols used in this manual 1
1.2 User precautions 1

General Description **2**

2.1 Introduction 2
2.2 PowerWave 9000 Model range 3
2.2.1 Advanced design features 4
2.3 Functional description of operation 5
2.3.1 PowerWave 9000 Module block diagram 5
2.3.2 UPS Module operating modes 6
2.3.3 UPS System operating modes 8
2.3.4 Multi-module parallel system operation 9
2.4 PowerWave 9000 User controls 11
2.5 UPS Module control panel 13
2.5.1 UPS Module control panel keys 14
2.5.2 Module mimic leds 15
2.5.3 Power Management Display (PMD) 15
2.6 Warranty 20
2.7 Extended Warranty 20
2.8 Additional Service/Maintenance Support 20

Installation **22**

3.1 Introduction 22
3.2 Taking receipt of the UPS 22
3.2.1 Site transportation 22
3.3 Unpacking 23
3.4 Storage 23
3.5 Planning the installation (site considerations) 24
3.5.1 Clearances 24
3.6 Planning the installation (cabling considerations) 25
3.6.1 General requirements 25
3.6.2 UPS Cable and fuse sizing 25
3.6.3 UPS Power cable termination sizes 28
3.6.4 UPS Power connection details 28
3.6.5 Power cabling in a multi-cabinet installation 30
3.6.6 Battery cabling considerations 31
3.7 UPS Cabling procedure 35
3.7.1 Connecting the input cables 35
3.7.2 Connecting the UPS output cables 36
3.8 Battery cabling procedure 40
3.8.1 Connecting the battery cables 40
3.9 Multi-cabinet configuration and paralleling cables 41
3.10 Optional remote monitoring and control facilities 42

Operation **43**

4.1 Introduction 43
4.1.1 Operating procedure summary 43
4.2 Operating Instructions 43
4.2.1 Starting the UPS system from the maintenance bypass 44
4.2.2 Individual module start/stop procedure in a parallel system 45
4.2.3 Transfer the load from UPS to maintenance bypass mode 47
4.2.4 Complete system shutdown 49
4.3 Replacement of the UPS module in a single module system 50
4.3.1 Removing a UPS Module in a single module system (e.g. DPA-50) 50
4.3.2 Refitting the UPS module 51
4.4 Replacing a module in a REDUNDANT multi-module system 51
4.4.1 Removing the UPS module 51
4.4.2 Inserting a UPS module 52
4.5 Replacing a module in a CAPACITY multi-module system 52
4.5.1 Removing a module 53
4.5.2 Refitting a module in a capacity multi-module system 54

Maintenance **55**

5.1 Introduction 55
5.2 System calibration 55
5.3 User responsibilities 55
5.4 Routine maintenance 55
5.5 Battery testing 56
5.6 Battery maintenance 56
5.7 Battery disposal and recycling 56

Troubleshooting **57**

6.1 Alarms 57
6.2 Menu, Commands, Event Log, Measurements, 57
6.3 Fault Identification and Rectification Messages and Alarms 58
6.4 Contacting Service 58

Options **59**

7.1 Introduction 59
7.2 Dry port (volt-free contacts) 60
7.2.1 Input interfaces terminal block X1 60
7.2.2 Output interfaces terminal blocks X2, X3, X4 61
7.3 RS232 Computer serial interface – USB & JD11 62
7.4 RS232 Interface for multidrop – JD12 62
7.5 SNMP/ Modem slots for remote monitoring/control 63
7.6 UPS Monitoring and automated control software 63
7.6.1 The importance of UPS management 63
7.6.2 WAVEMON Shutdown and Management Software 64
7.6.3 PowerREPORTER™ management software 65

Specifications **68**

8.1 Mechanical Characteristics 68
8.2 Input Characteristics 69
8.3 Battery 69
8.4 Output 70
8.5 Environmental 70
8.6 Packed weights 71
8.7 Cable and fuse sizing (Single feed input) 72
8.8 Cable and fuse sizing (Dual feed input) 73

1 Safety

1.1 Description of symbols used in this manual

WARNING: The warning symbol is used where there is danger of an electrical shock, equipment damage or personal-injury.

CAUTION: *The caution symbol is used to highlight important information to avoid possible equipment malfunction or damage.*

1.2 User precautions

WARNING: Keep this manual with the UPS for future reference.

WARNING: The UPS and peripheral equipment must be installed and commissioned by suitably qualified and trained personnel who are aware of the potential shock hazards.

WARNING: Do not attempt to install this UPS system until you are satisfied that ALL the safety instructions and hazard warnings contained in this manual are read and fully understood.

WARNING: High leakage current!
Ensure that the UPS has been correctly earthed before you connect the mains power supply!

WARNING: This UPS must not be started-up or put into use without having first been commissioned by a fully trained engineer authorised by the manufacturer.

WARNING: This UPS must be serviced by qualified personnel.
You run risk of exposure to dangerous voltages by opening or removing the UPS-covers! Uninterruptible Power Supplies Ltd will assume no responsibility nor liability due to incorrect operation or manipulation of the UPS.

WARNING: The PowerWave 9000 is a Class A UPS product
(according to EN 62040-3). In a domestic environment the UPS may cause radio interference. In such an environment the user may be required to undertake additional measures.

2 General Description

2.1 Introduction

Congratulations on your purchase of the PowerWave 9000 UPS.

Continuous power availability is essential in today's dynamic IT and process-related work environments. It is equally important that any installed power protection system is sufficiently resilient and adaptable to handle any changes brought about by the introduction of new server technologies, migration and centralization.

Such demands are well met by the PowerWave 9000 UPS system which provides the foundation for continuous power availability of network-critical infrastructures both in enterprise data centres, where business continuity has paramount importance, and in process control environments where manufacturing continuity is essential.

Reliability and quality standards

By using a unique modular construction and incorporating the latest technological developments in power engineering, the PowerWave 9000 represents a completely new generation of transformerless 3 phase UPS-System. Its advanced double conversion VFI (Voltage and Frequency Independent) topology responds fully to both the highest availability and environmentally friendly requirements compliant with IEC 62040-3 (VFI-SS-111) standards. A full UPS Specification is given in Chapter 8 of this manual.

High reliability, upgrade ability, low operating cost and excellent electrical performance are just some of the highlights of this innovative UPS solution.

Uninterruptible Power Supplies Ltd specialises in the installation and maintenance of Uninterruptible Power Systems; and this powerful UPS is just one example of our wide range of state-of-the-art power protection devices that will provide your critical equipment with a steady and reliable power supply for many years.

Key features

The highlights of this innovative UPS solution include its high reliability, upgrade ability, low operating costs and excellent electrical performance.

- *Decentralised Parallel Architecture (DPA)* – Highest availability, with near zero down time. Each UPS module contains its own bypass circuit, which greatly improves the overall system reliability by removing a common point of failure that is often present in more traditional UPS systems.
- *Truly modular design* – The PowerWave 9000 is designed around multiple 30kVA, 40kVA,or 50kVA UPS modules.
- *Hot-swappable modules* – Enables system expansion and module replacement to be carried out without disturbing the connected load.
- *Compact size, small foot print* – Up to 342kW/m² saving on expensive floor space.
- *Flexible battery management* – Advanced management of battery charging and preventive failure diagnostics avoids premature deterioration of battery life.
- *High ac-ac efficiency (up to 95.7%) even with partial loads* – Results in energy and operational cost savings (TCO)
- *Full power available from 0.9 lead to 0.8 lag* – Blade-server-friendly power; No de-rating required with leading power factor loads
- *Very low input current distortion* – THDi = < 3-4% @ 100-25% load leads to savings in generator-set power and installation costs.

2.2 PowerWave 9000 Model range

The PowerWave 9000 UPS is based on a range of 30kVA to 50kVA plug-in power modules fitted into one of three purpose-designed cabinets. Each power module is a self-contained UPS comprising a rectifier, battery charger, inverter and static switch; and when two or more modules are fitted into a cabinet they effectively operate as a parallel UPS system. The available cabinets can contain up to one, three or five power modules as shown below in Figure 2.1.

Key Point: All the modules fitted within a cabinet must be of the same rating – for example, it is not possible to mix 30kVA and 50kVA modules in the same cabinet.

The PowerWave 9000 cabinets are identified as CLASSIC DPA-50, TRIPLE DPA-150 and UPGRADE DPA-250 – where the model number represents the maximum kVA output available when the cabinet is fully populated with 50 kVA power modules. Figure 2.1 shows that the DPA-50 and DPA-150 cabinets include shelves for housing the UPS batteries; however the DPA-250 cabinet has no internal battery mounting facilities and requires an external battery cabinet. A range of matching battery cabinets is available which are installed adjacent to the UPS cabinet in the majority of installations. An additional (external) battery cabinet can also be connected to the DPA-50 and DPA-150 models to extended the overall system autonomy time if desired.

		CLASSIC DPA-50	TRIPLE DPA-150	UPGRADE DPA-250
Power module capacity	Max.	1 module (30-50kVA) 280 x 7/9Ah batteries	3 modules (30-50kVA) 240x 7/9Ah batteries	5 modules (30-50kVA) External batteries
Maximum power connection	kVA	50	150	250
Dimensions (WxHxD)	mm	730x1650x800	730x1975x800	730x1975x800
Weight of empty frame	kg	262	239	205
Weight of frame with modules fitted (but without batteries)	kg	305 - 309 (with 1 Module)	368 - 379 (with 3 Modules)	420 - 439 (with 5 Modules)
Colours		Front: RAL 9007 + black (inlets). Sidewalls: Graphite grey		

Figure 2.1 PowerWave 9000 Cabinets (frames)

		DPA 30 Module	DPA 40 Module	DPA 50 Module
Output Apparent Power	KVA	30	40	50*
Output Active Power	KW	24	32	40
Output Power (PF=1)	KVA / KW	24 / 24	32 / 32	40 /40
Number of 12V Battery Blocks	No.	40-50	40-50	40-50
Dimensions (WxHxD)	mm	663 x 225 x 720		
Weight UPS Module	kg	43.1	45.3	46.8
Colours		Front: Graphite grey		
* On Inverter mode 50 KVA/40kW on Bypass mode 45 KVA/40kW				

Figure 2.2 PowerWave 9000 UPS Power Modules

2.2.1 Advanced design features

Hot-swappable modules

In a redundant module system the unique 'hot-swappable' feature enables a UPS power module to be inserted or removed from its cabinet whilst it is still powered (*hot*) without having to shut down the load or transfer it to the bypass supply.

Note: *In a non-redundant system the load will unavoidably have to be transferred to the bypass supply while a module is shut down or removed from the system.*

Advanced booster technology

The UPS power module's inbuilt advanced booster technology results in a perfect sinusoidal input power quality at 0.99 input power factor with a harmonic content of less than 3% THD(i). This leads to a more reliable system operation together with savings in generator and transformer sizing due to reduced winding losses; and also means that traditional input harmonic filters (still used by some systems) are not required.

The high power factor presented by the UPS on the incoming mains supply minimises cabling and fusing costs due to the reduced reactive power consumption which, together with the accompanying low harmonic currents, provides the following benefits:

- No additional losses in wires and cables
- No extra heating of transformers and generators
- No over sizing of generators
- No false circuit breaker tripping and malfunction
- No erratic operation of computers, telecommunications, monitors, electronic test equipment etc.
- No resonance with power factor correction capacitors

Flexible battery management (FBM)

Premature battery deterioration is avoided by the advanced management of battery charging and preventive failure diagnostics. The major benefits are:

- AC-ripple-free battery charging due to a dedicated dc-dc charger independent from the rectifier and inverter
- Wide range of number of battery blocks (30-50 x 12V blocks, depending autonomy times)
- Wide UPS input voltage operating window extends the battery life due to fewer discharge cycles
- Battery discharge protection caused by load jumps
- Proactive battery protection from false manipulations and inadequate charging voltages
- Proactive battery failure detection thanks to the Advanced Battery Diagnosis (ABD) algorithm
- User-selectable battery tests to ascertain the battery state
- Optional temperature compensated charging regime to enhance battery life

Decentralised Parallel Architecture (DPA)

In a 'redundant' parallel UPS system the power modules' outputs are connected in parallel so that if one module fails the remaining modules can sustain the load supply. Such operation requires a certain amount of inter-module communication to control frequency synchronisation, load sharing, load transfer etc. This is achieved by having a *master-slave* relationship among the power modules whereby the *master* logic gives out individual commands to all the *slave* units to keep them in step.

In some designs this can unfortunately lead to a single-point-of-failure for the entire system if the master logic or communication with the slaves fails; however, the PowerWave 9000 technology uses *multi-master* logic with separated independent regulation and control logic busses which enables *any* of the connected power modules to adopt the *master* role if called upon. This control philosophy maintains the highest possible system availability.

This unique decentralized design:

- Enables a parallel redundant system providing 100% conditioned power at all time
- Eliminates the system-level single point of failure inherent in traditional parallel UPS systems
- Exponentially increases the reliability of the overall system

2.3 Functional description of operation

This section describes:

- The internal operation of an individual UPS power module at block-diagram level (see paragraph 2.3.1)
- The various operational modes of an individual UPS power module (see paragraph 2.3.2)
- UPS system operational modes – 'On-line' versus 'Off-line' system operation (see paragraph 2.3.3)
- Multi-module system operation and paralleling considerations (see paragraph 2.3.4)

2.3.1 PowerWave 9000 Module block diagram

Figure 2.3 shows a functional block diagram of a PowerWave 9000 cabinet containing two power modules.

UPS Input supplies

The mains supply (1) is a standard 3ph+N supply which is connected to the rectifier section of each power module. During normal operation this supply is rectified to provide a DC input to the inverter and also powers the battery charger.

A 3ph+N bypass supply (2) is shown connected via a fused isolator (F2) to the static switch within each power module. It is also to the cabinet's maintenance bypass switch (IA1). In a standard installation the bypass supply terminals (2) are usually linked to the mains supply terminals (1) within the cabinet so only one mains supply feed is required. (See paragraph 3.6.3 for details concerning 'Single Feed' & 'Dual Feed' input supply configurations.)

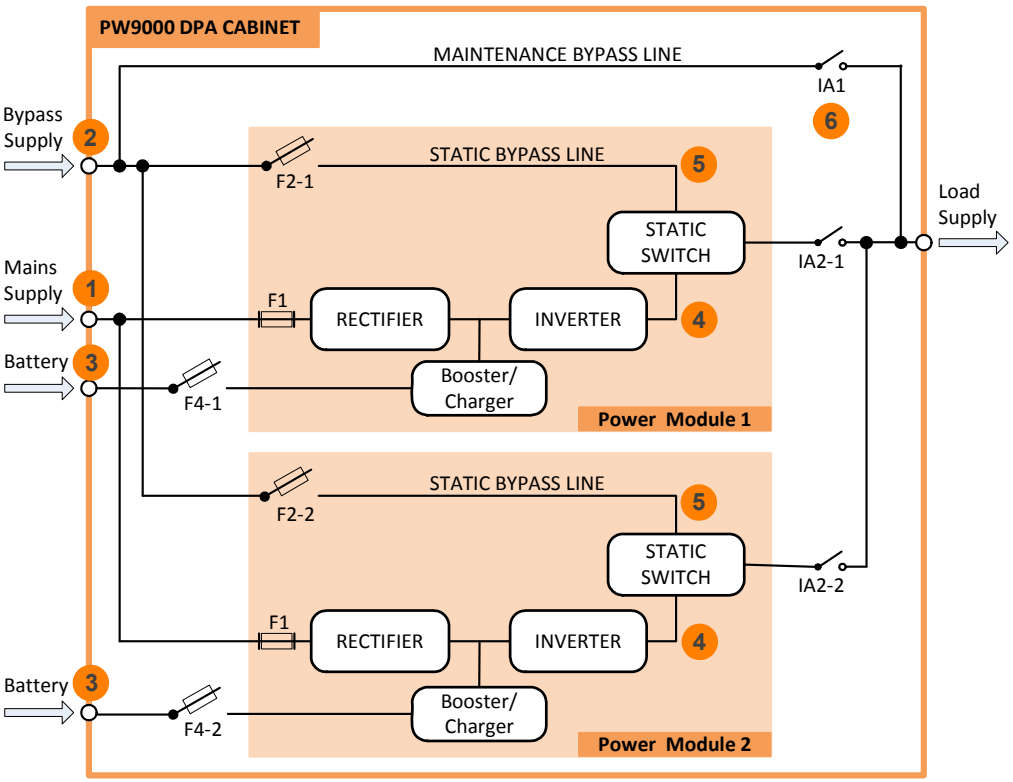


Figure 2.3 PowerWave 9000 UPS block diagram (2 modules fitted)

Each power module is wired to individual battery connections on the cabinet's main terminal block (3). This terminal block is then connected to internal batteries in the case of the DPA 50 and DPA 150 cabinets, or to an external battery cabinet in the case of the DPA 250.

If required, two or more power modules can be connected to a common battery by linking together the modules' battery terminal block connections (3), as described in paragraph 3.8. However, by employing a separate battery bank for each module it again avoids a potential single point of failure and effectively extends the system redundancy to include the batteries – which is highly recommended.

UPS Output (load) supply

Figure 2.3 shows that the UPS output (Load Supply) can be provided through one of three power paths depending on the UPS operating mode:

- From the inverter (4), via the static switch and isolator IA2
- From the static bypass line (5) via the static switch and isolator IA2
- From the maintenance bypass line (6) via the maintenance bypass isolator IA1

The criteria for operating under each of these UPS modes is described below.

2.3.2 UPS Module operating modes

The diagrams in this section illustrate cabinet fitted with a single power module. Where two or more power modules are fitted they will always adopt the same operating mode due to the parallel control logic signals.

Load on Inverter

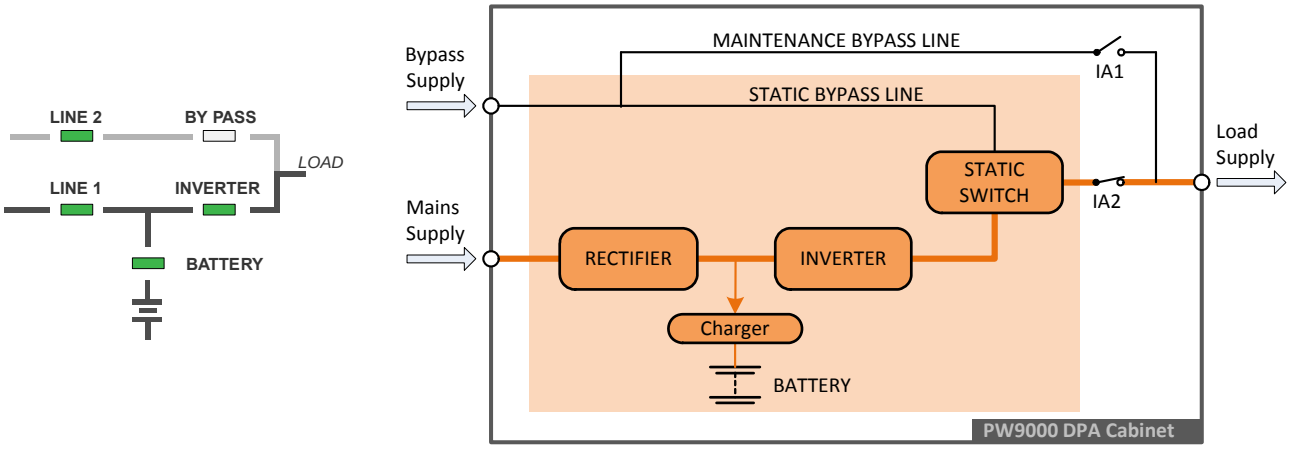


Figure 2.4 Load on inverter

This is the normal operating mode and the only one that provides the load with continuously processed and backed-up power. In this mode, the mains supply is converted to DC by the rectifier which then charges the battery and provides operating power for the inverter; which converts the rectifier output back to AC suitable for powering the load.

The inverter output frequency is synchronised to the bypass supply provided it remains within preset limits. If these limits are exceeded, or if the bypass supply fails altogether, the inverter frequency control reverts to a free-running oscillator that will produce a constant 50/60Hz UPS output.

Load on Battery

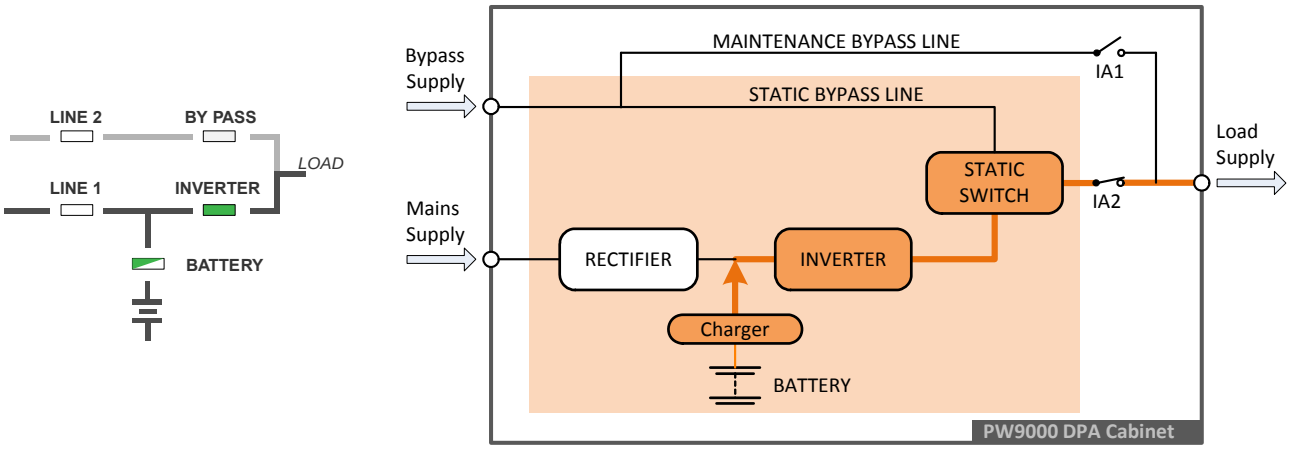


Figure 2.5 Load on battery

If the mains supply fails, the LINE 1 led will extinguish and the rectifier will shut down. The battery now provides an alternative DC power source for the inverter via the charger/booster and the BATTERY led will flash green to indicate that it is on load.

Larger installations often include a standby generator which is designed to start-up and connect to the UPS automatically within a short period of time following a mains failure. Once the UPS input power is restored from the standby source the rectifier and charger will resume normal operation, which results in very short battery discharge periods.

In the case of a dual feed input – if the bypass supply remains live, the LINE 2 led will stay illuminated and the inverter frequency will remain synchronised to the bypass provided it stays within its preset limits.

In the case of a single feed input – the bypass supply will fail at the same time as the mains supply and the LINE 2 led will extinguish along with the LINE 1 led. Under these circumstances inverter frequency will revert to a free-running oscillator that will produce a constant 50/60Hz UPS output.

Battery discharge operation

Various alarms are generated at preset levels as the battery discharges. This allows the operator observe the remaining autonomy and, if required, shut-down the load in an orderly manner (e.g. to save data) before the battery reaches its final end-of-discharge voltage. Various options are available to automate the load shut-down process, as described in Chapter 8 of this manual (Options).

When the battery is initially put on load the BATTERY led will flash green, as shown in Figure 2.5. This will continue until the remaining autonomy time falls to 3 minutes whereupon the led will begin flashing red and if a data protection application, such as WAVEMON, is installed it will begin its automatic PC shutdown routine at this point.

When the battery reaches its fully discharged voltage the BATTERY led will change to solid red and the UPS will attempt to transfer the load to the bypass supply if it is present.

Load on Bypass

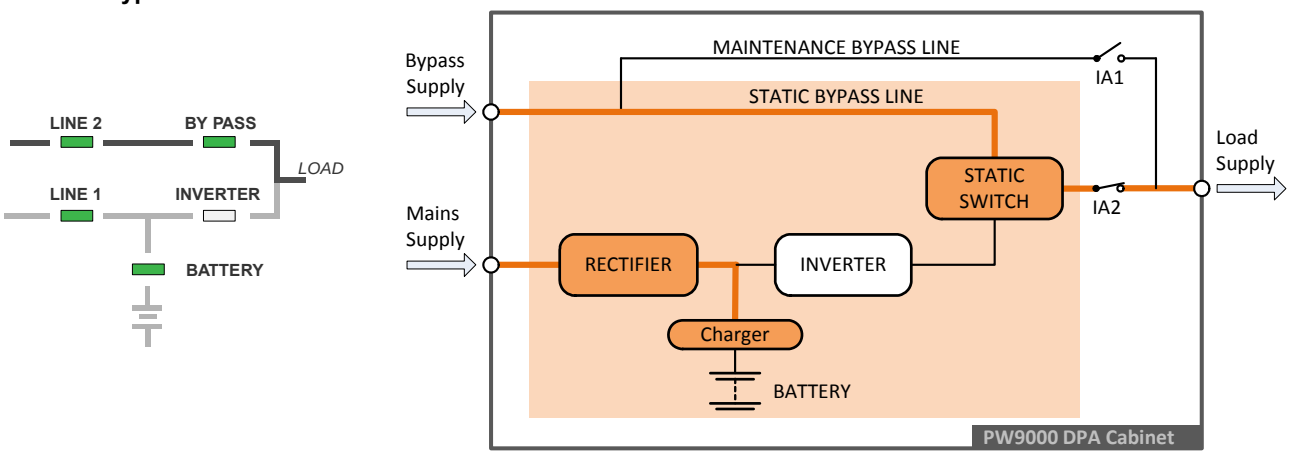


Figure 2.6 Load on bypass

In the 'load on bypass' mode the load supply is connected to the unprocessed static bypass line via the static switch.

Depending on the reason for switching to bypass operation (i.e. manually transferred or transferred due to a fault), when operating in this mode the rectifier/charger section can be turned off entirely or remain running, and continue to provide battery charging (as shown above). Similarly, the inverter may have been manually turned OFF or shutdown due to a fault, and the INVERTER led may be OFF or solid RED.

Static switch operation

The static switch is a solid state switch contained in each power module and operated by the module's microprocessor control logic which ensures that the static switch of all the power modules connected to the load (through IA2) are always in the same operational state. It is not permissible for one module to be operating with 'load on inverter' while the remaining modules are in the 'load on bypass' mode as such a situation would cause damage to the modules.

During normal operation the load is transferred from the inverter to the static bypass line in the event of an overload or loss of system redundancy due to a failed power module. Load transfer can also be initiated manually via the UPS operator control panel located on the front cabinet door *(see paragraph 2.3.3)*.

Load on Maintenance Bypass

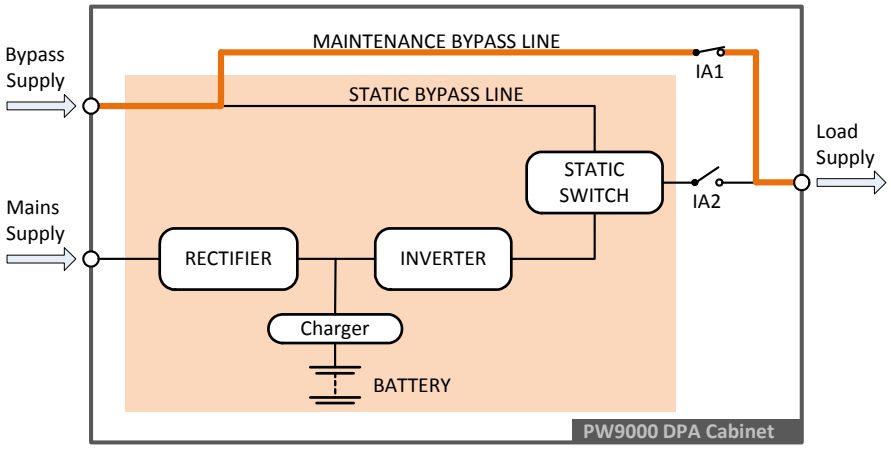


Figure 2.7 Load on maintenance bypass

In this mode of operation the manually closed maintenance bypass switch (IA1) connects the load supply directly to the unprocessed bypass supply. This is used to keep the load supplied (albeit without any power protection) whilst allowing the remainder of the UPS system to be shut down for service repair.

To prevent possible inverter damage, it is important that the inverter output and maintenance bypass lines are never connected in parallel. Therefore when transferring from the 'load on inverter' mode to the 'load on maintenance bypass' mode it is important that the load is first transferred to the static bypass ('load on bypass' mode) before the maintenance bypass switch is closed.

WARNING: always follow the operating instructions in this manual when starting or shutting down the UPS.

2.3.3 UPS System operating modes

The previous section described the operating modes of the UPS power module: but UPS systems are also categorised according to the way in which they are used at a 'system' level; and are typically described as being an 'on-line', 'off-line' or 'line interactive' UPS system. The PowerWave 9000 can be operated in all three of the above categories.

On-line operation

When used as an 'on-line' UPS system, the PowerWave 9000 UPS modules normally operate in their 'load on inverter' mode and will switch over to 'load on bypass' in the event of an inverter fault or overload which exceeds the system redundancy. This will transfer the load to the static bypass without interruption (transfer time = 0).

If the transfer is due to an overload the UPS modules will switch back to the 'load on inverter' mode if the overload clears and the inverter returns to normal operation. An 'on-line' system therefore provides the highest degree of load protection and is always recommended if the critical load will not tolerate even a very brief supply interruption.

Off-line / line interactive operation

When the PowerWave 9000 is used as an 'off-line' or 'line-interactive' UPS system it normally operates in its 'load on bypass' mode with the load being supplied through the static bypass supply; however the rectifier and battery charger are still powered up to maintain battery charging, and the inverter section is enabled and operating on standby.

In the bypass supply fails the static switch will automatically transfer the load to the inverter within 3-5ms, and if the rectifier input mains supply is missing when the transfer takes place the inverter will operate from battery power.

If the bypass supply returns to normal when operating with the 'load on inverter', the load automatically transfers back to the static bypass ('load on bypass' mode) and the inverter returns to its standby function.

An 'off-line/line interactive' system is a slightly more efficient than an 'on-line' system due to the reduced rectifier/inverter losses during normal operation and it is sometimes referred to as the "ECO" mode. However this mode is recommended only if the connected load equipment can tolerate power interruptions of up to 3 to 5 ms during the transfer period.

WARNING: The on-line mode must always be used for critical load protection.

2.3.4 Multi-module parallel system operation

As described above, the PowerWave 9000 cabinets are designed to accommodate between one and five UPS power modules. Each module has an individual output power isolator (IA2) which connects the module's output to the cabinet's output power terminals. This enables an individual module to be disconnected from the load supply for maintenance or repair purposes.

Under normal conditions all the modules within the cabinet are turned on and operating in parallel to provide the cabinet's rated output.

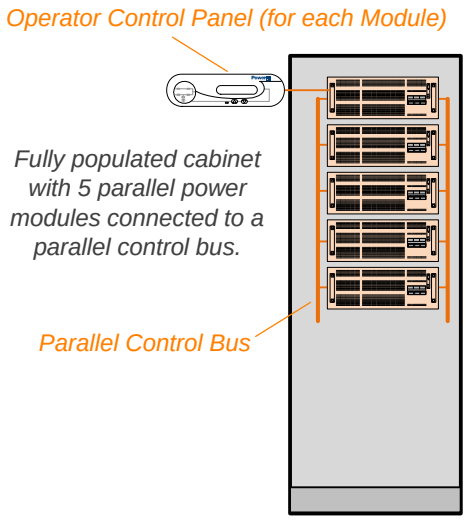

Operator Control Panel (for each Module)
Fully populated cabinet with 5 parallel power modules connected to a parallel control bus.
Parallel Control Bus

Figure 2.8 Single cabinet with five parallel power modules

'Capacity' versus 'redundant module' system

The paralleled UPS modules can be operated as either a *capacity* or *redundant* module system.

The difference between the two is that a 'capacity' system is rated such that ALL the power modules are required to furnish the specified full load power, whereas a 'redundant-module' system is designed with one (or more) modules over and above that required to supply the full load.

In a redundant-module system it is therefore possible to lose one (or more) power module without disrupting the load, whereas this is not the case in a capacity system where the loss of one power module would automatically transfer the load to the bypass supply.

Parallel control bus

All the UPS power modules within a cabinet are connected to a parallel control bus which carries various inter-module control signals used for frequency synchronisation, load sharing etc. By using sensing signals passed over the parallel control bus, each power module can electronically compare its own frequency and output current with that of its neighbouring module and carry out fine adjustments to achieve balanced conditions.

The module control logic always observes one of the power modules as being the 'master' and the others as 'slaves'. However if the 'master' module goes faulty at any time the next module in the chain (a former 'slave') will immediately take over the role of master and the former master module will turn off.

Multi-cabinet parallel system

To further expand the overall UPS system capacity, several (up to ten) PowerWave 9000 cabinets can be connected together to operate as a 'multi-cabinet' parallel system. This is achieved by connecting each cabinet's output power terminals in parallel at an external load distribution panel and linking together the parallel control bus in each cabinet to effectively provide a single parallel control bus that is connected to every power module in the system – see Figure 2.9.

Taken to its limit, a system comprising ten fully populated DPA-250 cabinets would result in a UPS system rating of 2500kW; however, such large systems are rare and a typical multi-cabinet installation will contain far fewer than the maximum ten cabinets.

It is essential that any installed UPS power protection system can be expanded to meet a growing load demand without compromising the existing load supply.

This condition is easily managed by a PowerWave 9000 system which, due to its 'hot-swappable' design, makes it possible to fit an additional power module to a DPA-150 or DPA-250 cabinet if it is not already fully populated, or add a further cabinet to an existing UPS system without disrupting the load supply.

***Note:** Every standard PowerWave 9000 cabinet is supplied with all the features required for parallel operation to eliminate any need for time-consuming or expensive upgrading on site.*

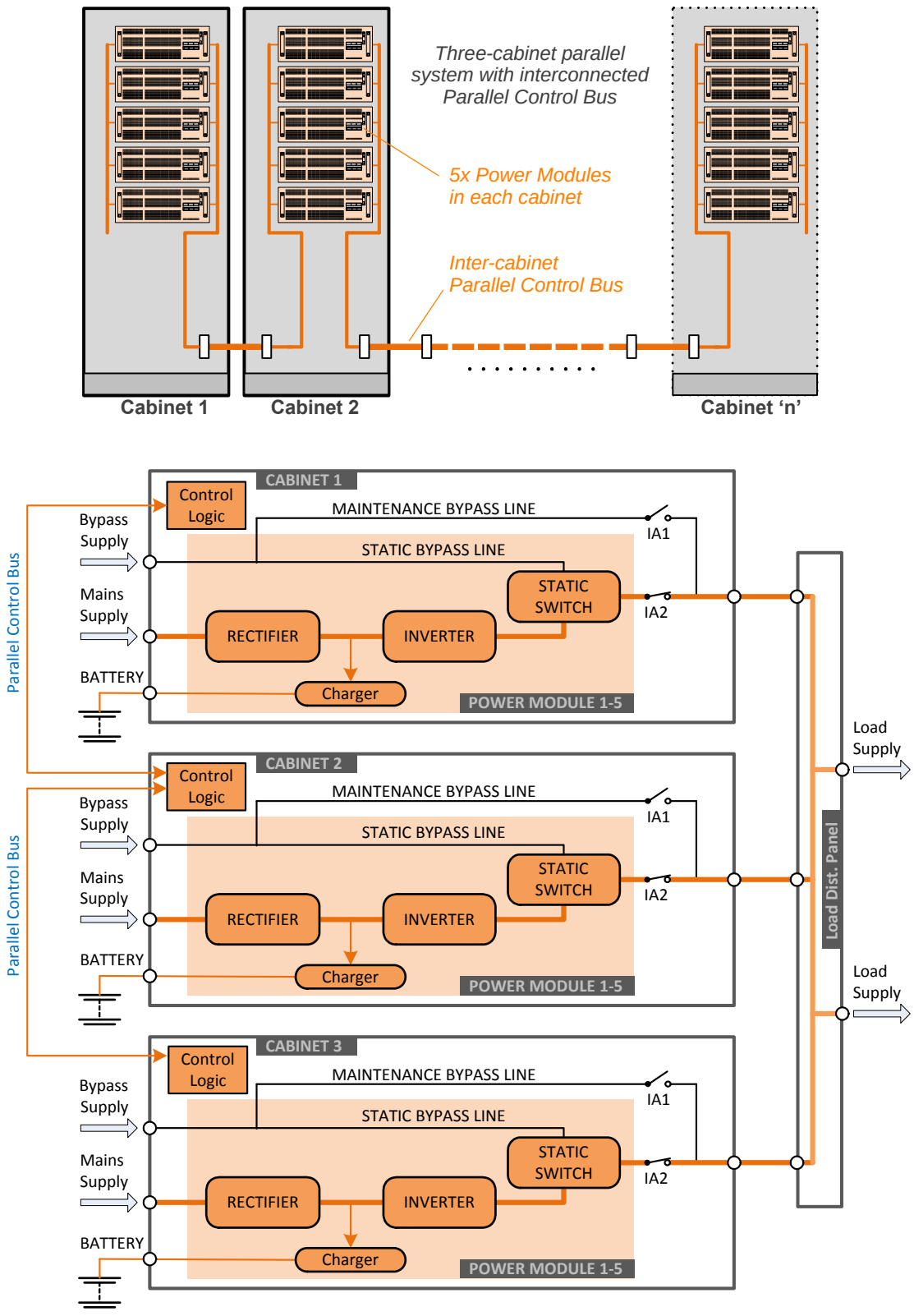


Figure 2.9 PowerWave 9000 UPS Parallel cabinet system

2.4 PowerWave 9000 User controls

The following illustrations show the location of the PowerWave 9000 power switches and fused isolators that are used when operating the equipment. Note that the input mains fuse (F1) is located within the module and is not accessible with the module in-situ. The Operator Control Panel (one per UPS module) is described in paragraph 2.5

DPA-50 Component identification

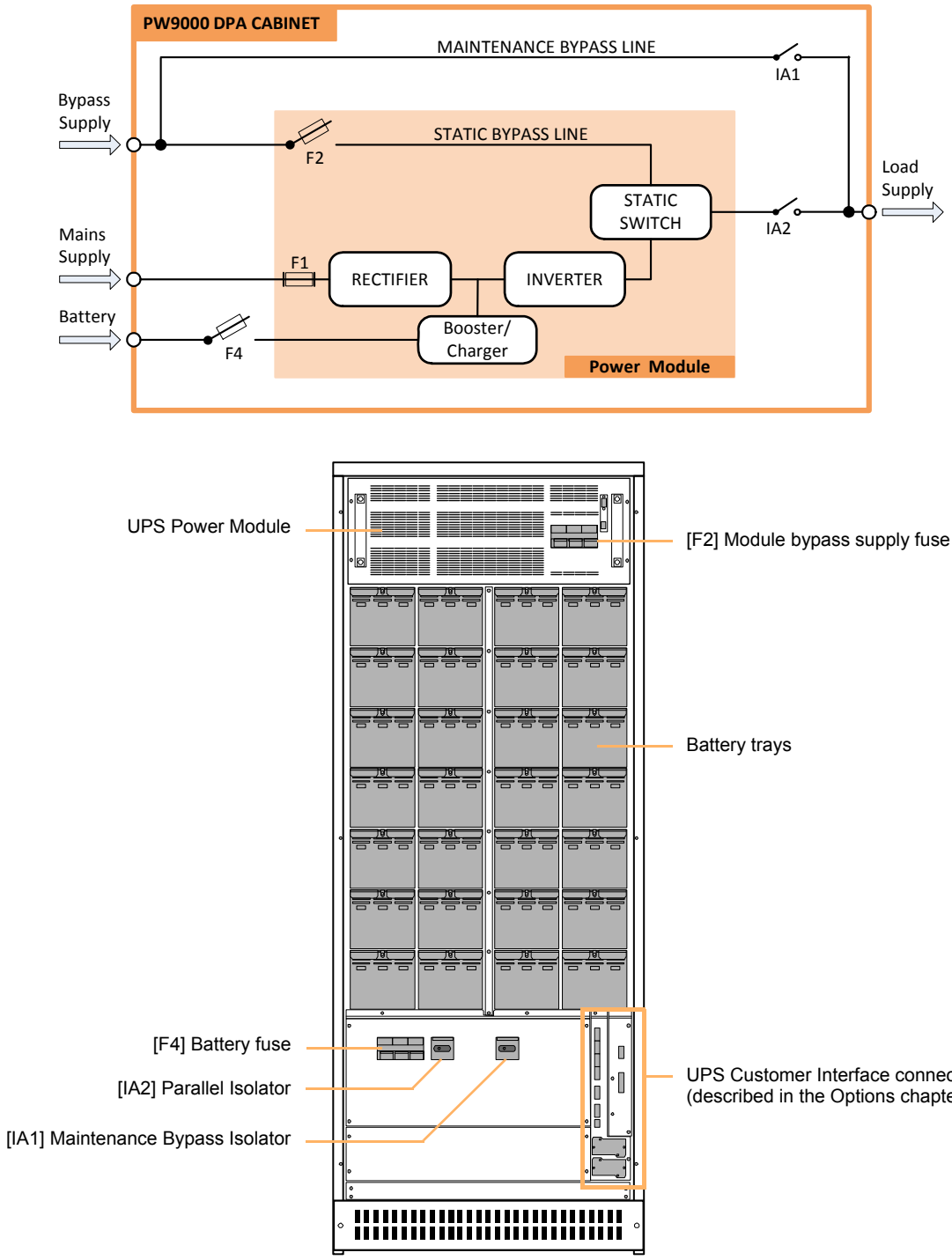


Figure 2.10 DPA-50 Cabinet details

DPA-150 Component identification

The DPA-150 can be fitted with up to three UPS power modules, with the uppermost module identified as module 1.

The battery fuses (F4) are identified with their associated power module on the panel silk-screen – e.g. F4-2 is the battery fuse associated with module 2. The module parallel isolator switches (IA2) are similarly identified – e.g. IA2-2 pertains to power module 2.

Note that the module input mains fuses (F1) are located within the modules and are not accessible with the module in-situ.

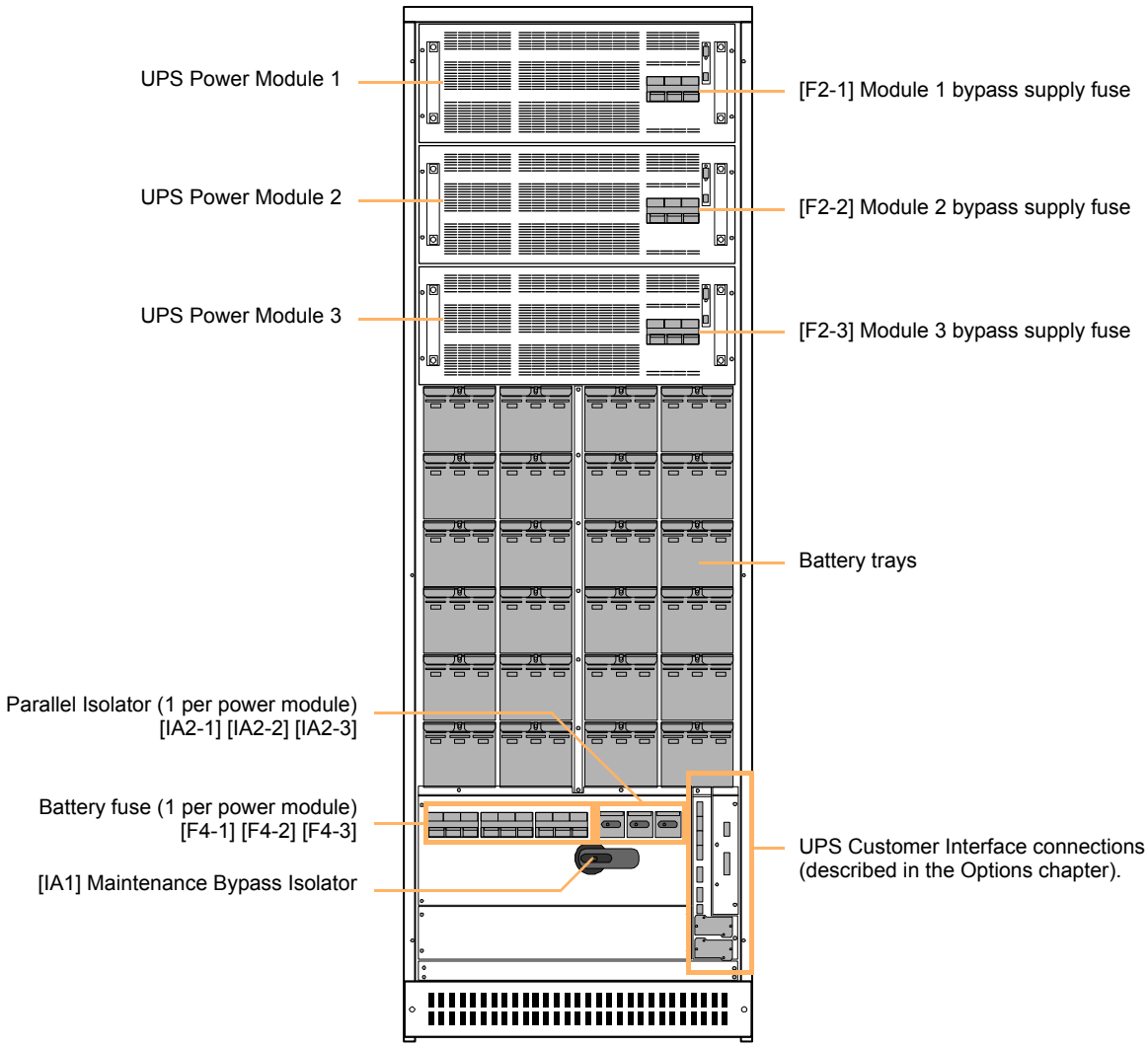

UPS Power Module 1
UPS Power Module 2
UPS Power Module 3
[F2-1] Module 1 bypass supply fuse
[F2-2] Module 2 bypass supply fuse
[F2-3] Module 3 bypass supply fuse
Battery trays
Parallel Isolator (1 per power module)
[IA2-1] [IA2-2] [IA2-3]
Battery fuse (1 per power module)
[F4-1] [F4-2] [F4-3]
[IA1] Maintenance Bypass Isolator
UPS Customer Interface connections
(described in the Options chapter).

Figure 2.11 DPA-150 Cabinet details

DPA-250 Component identification

The DPA-250 contains no batteries and can be fitted with up to five UPS power modules, with the uppermost module identified as module 1.

The module parallel isolator switches (IA2) are identified with their associated power module on the panel silk-screen – e.g. IA2-2 pertains to power module 2.

Note that the module input mains fuses (F1) are located within the modules and are not accessible with the module in-situ.

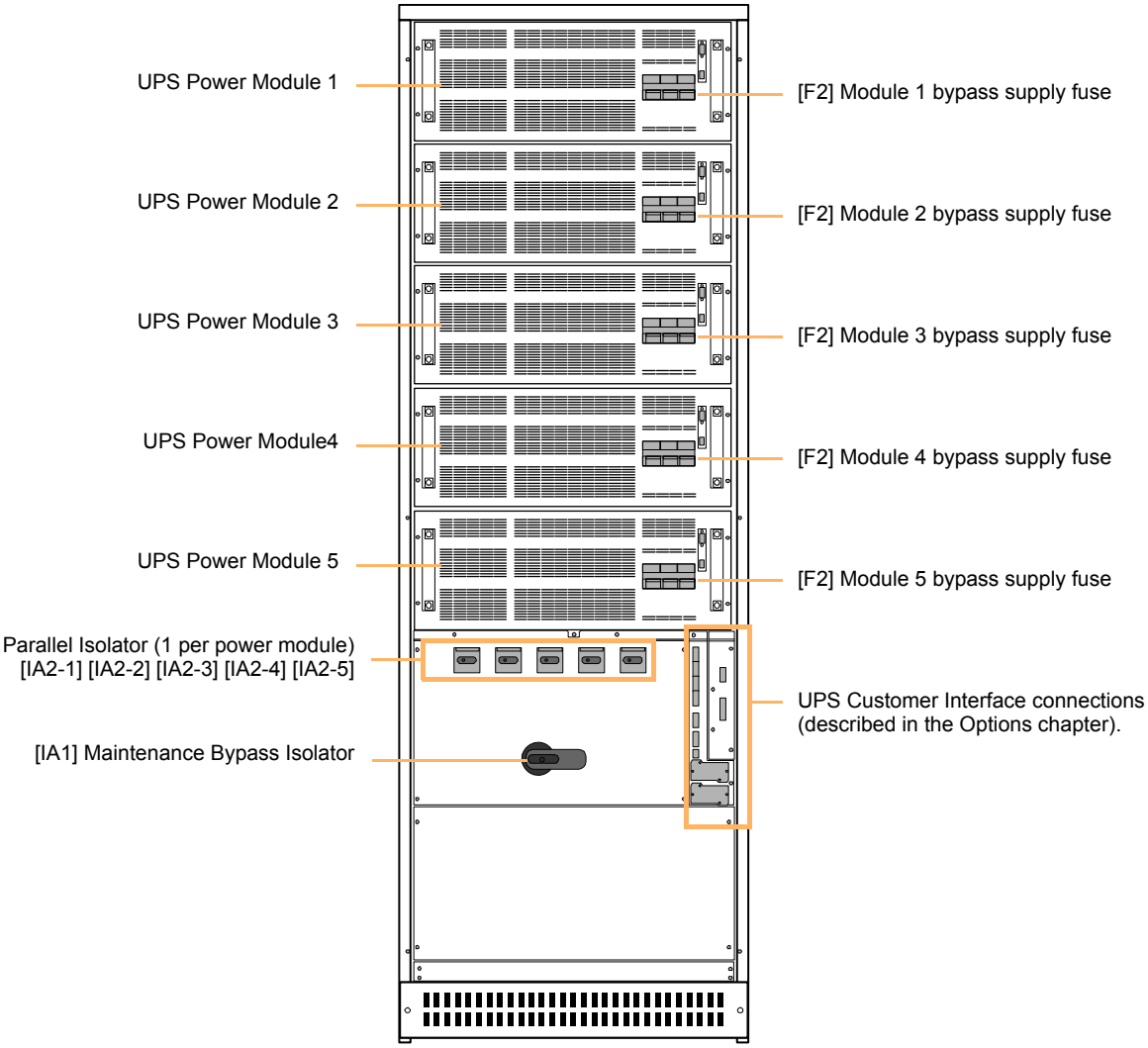

UPS Power Module 1
UPS Power Module 2
UPS Power Module 3
UPS Power Module4
UPS Power Module 5
Parallel Isolator (1 per power module)
[IA2-1] [IA2-2] [IA2-3] [IA2-4] [IA2-5]
[IA1] Maintenance Bypass Isolator
[F2] Module 1 bypass supply fuse
[F2] Module 2 bypass supply fuse
[F2] Module 3 bypass supply fuse
[F2] Module 4 bypass supply fuse
[F2] Module 5 bypass supply fuse
UPS Customer Interface connections
(described in the Options chapter).

Figure 2.12 DPA-250 Cabinet details

2.5 UPS Module control panel

The UPS module control panel is used to start/stop an individual module as part of the UPS system operating procedures.

It can also be used to configure and test a module's operating parameters during troubleshooting and commissioning, and monitor the module's input/output/battery values during normal operation.

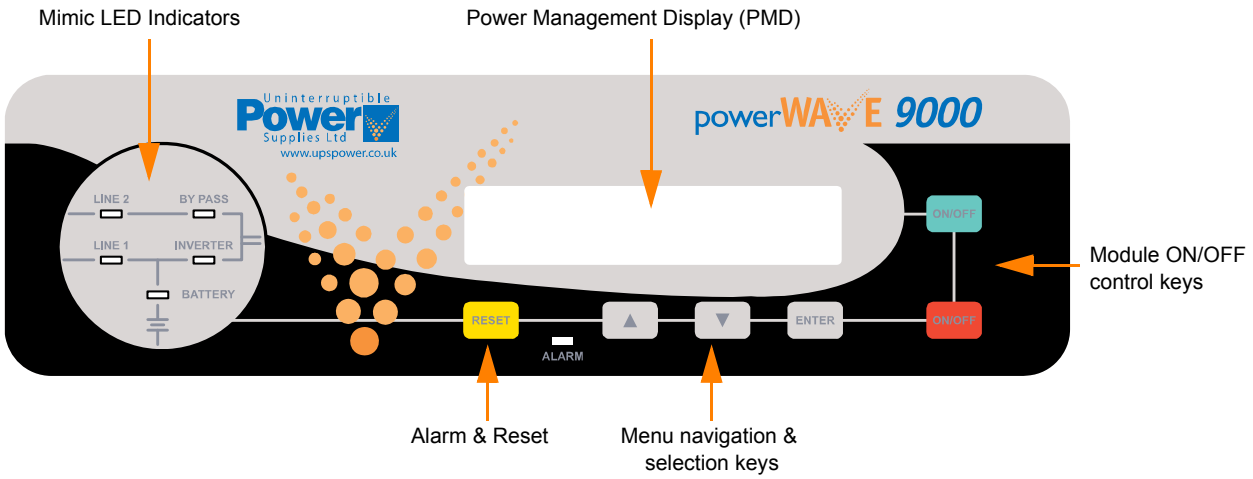


Figure 2.13 UPS Module control panel

2.5.1 UPS Module control panel keys

The keys on the operator control panel allow the user to:

- Make settings and adjustments via a menu driven LCD display
- Start-up and shut-down the UPS and transfer the load between inverter and bypass
- Monitor and display the UPS operating voltages, currents, frequencies and other values on the LCD display
- Reset/cancel an alarm

Key function summary

KEYS	FUNCTION
ON/OFF ON/OFF	Used to switch-on or switch-off the UPS
UP (▲)	Scroll upwards through a displayed menu
DOWN (▼)	Scroll downwards through a displayed menu.
ENTER	Confirms (selects) a chosen menu item.
RESET	Cancels an audible alarm. If the alarm condition was transient the ALARM LED will also extinguish, otherwise it will remain ON (red).

ON/OFF Keys

The UPS can be switched ON or OFF by simultaneously pressing both ON/OFF keys on the control panel. The requirement to press both buttons is to help avoid accidental UPS start-up or shutdown operation.

During normal operation, pressing the two ON/OFF buttons simultaneously will immediately shutdown the UPS module.

- In a single module system (e.g. DPA-50) this will disconnect the UPS from the load unless the load is first transferred to the maintenance bypass.
- In a parallel module system the power module will shutdown and be disconnected from the load bus. However, the load may or may-not transfer to the static bypass depending on whether or not the number of remaining live modules satisfies the system's redundancy – i.e. if there are a sufficient number of modules remaining to support the system's load then the load will not be transferred.

Note: To shut down all the modules in a parallel system you must press both ON/OFF buttons on every module.

2.5.2 Module mimic leds

The mimic diagram leds indicate the status of the general UPS power flow and change colour between Green and Red (and OFF) to indicate the present UPS operating conditions.

LED Indication summary

Indicator	Indicator Status	Interpretation
LINE 1	GREEN RED	Input mains available Input mains not available
LINE 2	GREEN RED	Bypass mains bypass OK Bypass mains bypass not OK or not present
ALARM*	OFF Flashing RED + buzzer RED	No alarm condition Alarm condition Alarm condition present (audio has been reset)
INVERTER	GREEN RED OFF	Load on inverter Inverter fault Inverter not operating
BY-PASS	GREEN OFF	Load on bypass Bypass not operating
BATTERY	GREEN RED Flashing RED Flashing GREEN	Battery OK Battery faulty or discharged Battery fuses blown On Battery

** The ALARM LED is a visual indication of an internal or external alarm condition. When activated, it is accompanied by an audible alarm which can be cancelled by pressing the RESET key.*

2.5.3 Power Management Display (PMD)

The 2 x 20 character LCD Power Management Display (PMD) simplifies communication with the UPS power module and also provides monitoring information.

The menu driven LCD enables the access to:

- Access the 'Event register'.
- Monitoring the input and output voltage, current, frequency & power.
- Monitoring battery run time.
- Perform commands such as module START and STOP, Load transfer between INVERTER to BYPASS.
- Access the module's Diagnostics (service mode).
- Carry out module adjustments and testing (service mode).

Status screens

DESCRIPTION	LCD-DISPLAY
1. Load is protected by UPS power Load is supplied by inverter (Normal Operation).	LOAD Unit:01/1 PROTECTED
2. Load is not protected by UPS Load is supplied by mains power (load on bypass).	LOAD Unit:01/1 NOT PROTECTED
3. Load supply completely interrupted. UPS has been switched off by "ON/ OFF" buttons.	LOAD OFF Unit:01/1 SUPPLY FAILURE
4. UPS/module is not supplying load. The output switch is open	LOAD DISCONNECTED Unit:01/1 PARALLEL SWITCH OPEN

***Note:** The 'Unit' number on the right hand side of the LCD indicates the cabinet number (in a multi-cabinet system) together with the UPS power module (slot) number within the cabinet. The maximum number of Module units is 10 and the module slot number can vary from 1 to 5. The definition of a Module's position is achieved in the menu Service Set-Up. For example:* Unit:05/3 *indicates power module number 3 in system Cabinet number 5.*

DESCRIPTION	LCD-DISPLAY
1. Single Systems.	SYSTEM CONFIGURATION Unit:01/1 SINGLE
2. Parallel System e.g. First Cabinet/Master Modules no 2 in slot 2.	SYSTEM CONFIGURATION Unit:02/2 PARALLEL
3. Parallel System e.g. Second Cabinet/Slave Modules no 5 in slot 3.	LOAD OFF Unit:05/3 SUPPLY FAILURE
4. Parallel System e.g. Second Cabinet/Slave Modules no 6 in slot 2.	LOAD DISCONNECTED Unit:06/4 PARALLEL SWITCH OPEN

Main menu screen

DESCRIPTION	LCD-DISPLAY
1. A log of the last 64 events is stored in the Power Management Display.	→ EVENT LOG MEASUREMENTS
2. Allows monitoring of voltages, power, frequencies, currents, autonomy etc.	→ MEASUREMENTS COMMANDS
3. Enables the commands “Load to inverter”, “Load to bypass” and battery test to be executed.	→ COMMANDS SET-UP DATA
4. Allows the UPS personalized information (such as serial number) to be entered.	→ SET-UP DATA SET-UP USER
5. Allows user to set up Date/Time, automatic battery test, etc.	→ SET-UP USER SET-UP SERVICE
6. Password-protected area for service engineer use only.	→ SET-UP SERVICE

Event log menu screen

DESCRIPTION	LCD-DISPLAY
1. Logging Control; a log of the last 64 events is stored in the Power Management Display.	01 05-10-08 14-38-56 LOAD TO INV.
2. Every stored event is identified with a sequential number and time stamp.	02 05-10-08 14-38-59 LOAD TO BYP.
3. By pressing ENTER the code of the event will be displayed.	03 05-10-08 14-39-14 LOAD OFF

Measurements menu screen

DESCRIPTION	LCD-DISPLAY
1. Battery Runtime	BATT. RUN TIME (MIN) 00h 00mm
2. UPS-Output Frequency	OUTPUT FREQUENCY (HZ) 50.00
3. Bypass Frequency.	BYPASS FREQUENCY (HZ) 50.00
4. Battery Voltage	BATTERY VOLTAGE (V) +0.0 −0.0
5. Battery Charger Current	BATT. CHARGE CUR. (A) +0.0 −0.0
6. Battery Discharge Current.	DISCHARGE CURRENT (A) 00.00
7. Rectifier Input Voltage (all three phases)	RECTIFIER VOLTAGE (V) 00.00 00.00 00.00
8. Bypass Input Voltage (all three phases)	BYPASS VOLTAGE (V) 00.00 00.00 00.00
9. Output Voltage (all three phases)	OUTPUT VOLTAGE (V)0 0.00 00.00 00.00
10. Output Current (all three phases)	OUTPUT CURRENT (A)0 0.00 00.00 00.00
11. Active Output Power (all three phases)	ACTIVE POWER (KW) 00.00 00.00 00.00
12. Reactive Output Power (all three phases)	REACTIVE POWER (kVAr) 00.00 00.00 00.00
13. Apparent Output Power (all three phases)	APPARENT POWER (KVA) 00.00 00.00 00.00
14. Output Power (all three phases)	OUTPUT POWER (%) 00.00 00.00 00.00
15. Battery capacity	BATT. CAPACITY (%) 00.00

Commands menu screen

DESCRIPTION	LCD-DISPLAY
1. Transfer Load to inverter	→ LOAD TO INVERTER LOAD TO BYPASS
2. Transfer Load to bypass.	→ LOAD TO BYPASS PERFORM BATT. TEST
3. Battery Test	→ PERFORM BATT. TEST

UPS Data menu screen

DESCRIPTION	LCD-DISPLAY
1. These general UPS Data are installed at the manufacturing plant.	UPS SERIAL NUMBER nn-nnnnn
2. Manufacturing date	DATE OF MANUFACTURE 15-03-09
3. EPROM Version	EPROM VERSION V-000
4. Actual Date and Time	DATE TIME dd-mm-yyyy hh:mm:ss

Set-up User menu screen

DESCRIPTION	LCD-DISPLAY
1. Set-up language	→ SET LANGUAGE SET DATE AND TIME ENGLISH FRANCAIS DEUTCH DUTCH SPANISH POLISH PORTOGUESE
2. Set-up Date and Time	→ SET-UP DATE/TIME SET-UP BATT. TEST DD-MM-YY HH-MM-SS
3. Set-up battery test	→ SET-UP BATT. TEST SET-UP GEN-SET OPER. DAY OF MONTH (1-31) HOUR OF DAY (0-23) REPETITIVE (Y/N) 000
4. Set-up operation with Gen-Set	→ SET-UP GEN-SET OPER. BATT.CHARGE LOCK (Y/N) BYPASS LOCK (Y/N)

Set-Up Service menu screen

DESCRIPTION	LCD-DISPLAY
1. This Menu is reserved for authorized service engineers. It is not to be used by End-Users.	→ SET-UP SERVICE PASSWORD
2. Type in password.	→ PASSWORD*

Key Point: It is essential to enter the password.

From within the Set-up Service menu a service engineer can adjust the UPS voltages, frequencies, currents, power and autonomies, together with setting up:

- UPS Rated Power
- Module configuration and position in the system
- Single (standard) or Dual input feed
- Frequency-converter, 50/60Hz and 60/50Hz
- Synchronisation window (2-4%).

2.6 Warranty

The PowerWave 9000 UPS is supplied with a limited warranty that the UPS and its component parts are free from defects in materials and workmanship for a period of one year from the date of original commissioning or fifteen months from the date of original delivery, whichever is the sooner. This warranty is the only warranty given and no other warranty, express or implied, is provided.

This warranty is invalidated if the UPS is put into use without having been commissioned by a fully trained and authorised person. This warranty does not apply to any losses or damages caused by misuse, abuse, negligence, neglect, unauthorised repair or modification, incorrect installation, inappropriate environment, accident, act of God or inappropriate application.

If the UPS fails to conform to the above within the warranty period then Uninterruptible Power Supplies Ltd. will, at its sole option, repair or replace the UPS. All repaired or replaced parts will remain the property of Uninterruptible Power Supplies Ltd.

As a general policy, Uninterruptible Power Supplies Ltd does not recommend the use of any of its products in life support applications where failure or malfunction of the product can be reasonably expected to cause failure of the life support device or to significantly affect it's safety or effectiveness. Uninterruptible Power Supplies Ltd does not recommend the use of any of its products in direct patient care. Uninterruptible Power Supplies Ltd will not knowingly sell its products for use in such applications unless it receives in writing assurances satisfactory to Uninterruptible Power Supplies Ltd that the risks of injury or damage have been minimized, the customer assumes all such risks and the liability of Uninterruptible Power Supplies Ltd is adequately protected under the circumstances

THE UPS SYSTEM MAY CONTAIN BATTERIES WHICH MUST BE RE-CHARGED FOR A MINIMUM OF 24 HOURS EVERY SIX MONTHS TO PREVENT DEEP-DISCHARGING. BATTERIES THAT HAVE BEEN, FOR WHATEVER REASON, DEEP-DISCHARGED ARE NOT COVERED BY THE WARRANTY.

2.7 Extended Warranty

The Standard Warranty may be enhanced by protecting the UPS with an Extended Warranty Agreement (maintenance contract). An Extended Warranty Agreement enhances the standard warranty by providing the following:-

- Regular preventative maintenance inspections.
- Guaranteed speed of response to operational problems.
- 24 hour telephone support.
- Fully comprehensive (excluding batteries) cover.
- Contact the Service Support Hotline on 0800 731 3269 for further details.

2.8 Additional Service/Maintenance Support

In addition to providing support for the PowerWave 9000, Uninterruptible Power Supplies Ltd can provide maintenance and support of a wide range of different UPS products.

If you are interested in an extended warranty for your PowerWave 9000, or any other UPS you may have, please complete the enquiry form shown opposite and return or FAX to:

Uninterruptible Power Supplies Ltd.
Woodgate
Bartley Wood Business Park
Hook
Hampshire
RG27 9XA

Tel: 01256 386700
0800 731 3269 (24 Hr.)

Fax: 01256 386701

Email: service@upspower.co.uk

Fax to: 01256 386701 **www.upspower.co.uk**

Uninterruptible Power Supplies Ltd
Woodgate
Bartley Wood Business Park
Hook
Hampshire
RG27 9XA
Tel: 01256 386700

Name: .....

Job Title: .....

Company: .....

Address: .....

.....

.....

.....

Post Code .....

Tel. .....

Fax. .....

E-mail .....

Please contact me to discuss:

☐ Extended Warranty options for my PowerWave 9000 UPS

☐ Extended warranty options for my UPS System as below:

Manufacturer:.....

Model Nº:.....

Rating kVA:.....

☐ Replacement Batteries.....

☐ Other .....(please specify)

Thank you for your enquiry, which will receive our prompt attention.
If you need to contact us immediately call free on,

Freephone 0800 731 3269

or E-mail us on service@upspower.co.uk

www.upspower.co.uk

3 Installation

3.1 Introduction

This chapter contains essential information concerning the unpacking, positioning, installing and cabling of the PowerWave 9000 UPS.

WARNING: All cabling operations must be supervised by an authorised electrician or other suitably qualified person. All installation and operating procedures must be carried out in strict accordance with the instructions contained in this manual. Uninterruptible Power Supplies Ltd will take no responsibility for any personal injury or material damage caused by the incorrect installation, cabling or operation of this product.

WARNING: Once the UPS equipment is installed it must be commissioned by an engineer approved by Uninterruptible Power Supplies Ltd before it is powered-up. Uninterruptible Power Supplies Ltd will take no responsibility for any personal injury or material damage caused by the application of electrical power to this equipment before it has been fully commissioned.

3.2 Taking receipt of the UPS

The UPS cabinet and accessories are delivered on purpose designed pallets that are easy to off load and move using a forklift or suitable pallet jack.

CAUTION: *Observe the following precautions when off-loading and moving the UPS:*

- *Always keep the packages in an upright position.*
- *Do not drop the equipment.*
- *Due to the high-energy batteries involved and heavy weight, do not stack the pallets.*

The packing container protects the UPS from mechanical and environmental damage during transit. This protection is further increased by wrapping the PowerWave 9000 UPS with a plastic sheet.

Upon receiving the UPS you should carefully examine the packing container for any sign of physical damage. The external 'Tip&Tel' (“FRAGILE” and “ARROW”) indicator should be intact if the equipment has been correctly transported in an upright position. If the packaging has been ruptured in transit, or if the 'Tip&Tel' indicator is suspect, inform both the carrier and Uninterruptible Power Supplies Ltd immediately.

CAUTION: *Claims for visible shipping damage must be notified to the carrier immediately on receipt. Other shipping damage claims must be filed immediately when found and the carrier must be informed within a maximum of 7 days following receipt of the equipment.*
If shipping damage is discovered, store all packing materials for further investigation.

Ensure that the received UPS equipment corresponds to the description indicated in the delivery note.

3.2.1 Site transportation

Please observe the following precautions when you transport the UPS equipment from the off loading site and its intended installation (or storage) location.

CAUTION: *Transportation:*

- *When transporting the equipment, use the front and rear shipping brackets to secure the cabinet to help prevent the UPS from toppling over.*
- *Do not at any time tilt the cabinet by more than 10° from vertical.*

CAUTION: *Potential dangers:*

- *If the UPS/battery cabinet is tilted by more than 10° it could cause internal damage. If tilting occurs do not connect the UPS to the mains electrical supply.*
- *The weight of the UPS/battery equipment can cause serious personal injury and/or structural damage to the surrounding area if dropped in transit. Always take extreme care when moving the equipment.*

CAUTION: *Storage:*

- *The UPS should be stored in the original packing and shipping carton.*
- *The recommended storing temperature for the UPS system and batteries is between +5°C and +40°C.*
- *The UPS system and the battery sets must be protected from high humidity which should not exceed 90% RH (non-condensing).*

3.3 Unpacking

WARNING: The UPS system, the battery cabinet (option) and the batteries are heavy and may tip during transportation causing serious injury if these unpacking instructions are not followed closely.

If the packages are received in good order (i.e. the 'tip & tell' "FRAGILE" and "ARROW" indications on the packing container are intact) then unpack the UPS and any accessory equipment as follows:

1. If the cabinet is shipped inside a wooden case, remove the screws at the base and sides of the case then carefully remove the case from the equipment.
2. Cut the wrappers and remove the packing container by pulling it upwards.
3. Remove the plastic sheeting covering the UPS.
4. Remove any anchor bolts securing the cabinet to the pallet then remove the UPS from the pallet.
5. Retain the packaging materials for future shipment of the UPS.
6. Examine the UPS for any sign of damage and notify your supplier immediately if damage is found.
7. Check that the details on the UPS nameplate corresponds to the purchased material mentioned in the delivery note. The rating specifications can be found on a nameplate located inside the UPS door.
8. Open the cabinet door and ensure that all the UPS power modules are correctly and securely fitted in their compartments. Ensure that a protection cover is fitted to the front of any empty compartments.

3.4 Storage

UPS Cabinet

If you plan to store the UPS cabinet prior to use it should be held it in a clean, dry environment with a temperature between -5°C to +40°C and RH <90%. The UPS should preferably be stored in the original packing and shipping carton, but if the packing container is removed you must take measures to protect the UPS from dust.

Battery

The UPS uses sealed, maintenance-free batteries whose storage capacity depends on the ambient temperature. It is important not to store the batteries for longer than 6 months at 20°C, 3 months at 30°C, or 2 months at 35°C storage temperature without recharging them.

For longer term storage the batteries should be fully recharged every 6 months @20°C.

CAUTION: *Sealed batteries must never be stored in a fully or partially discharged state. Extreme temperature, under-charge, overcharge or over-discharge will destroy batteries!*

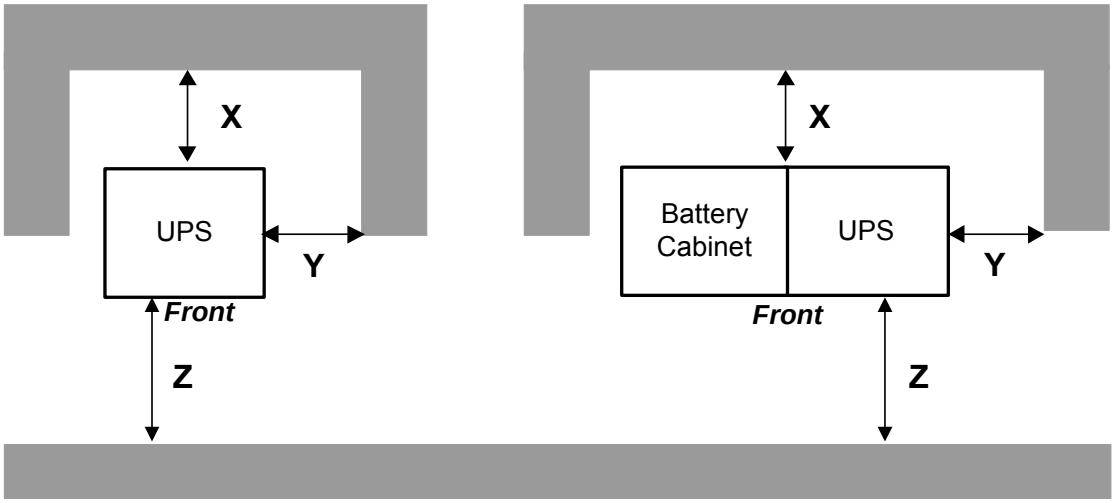
- *Charge the battery both before and after storing.*
- *Always store the batteries in a dry, clean, cool environment in their original packaging.*
- *If the packaging is removed protect the batteries from dust and humidity.*

3.5 Planning the installation (site considerations)

A certain amount of pre-planning will help ensure a smooth and trouble-free installation of the UPS system. The following guidelines should be taken into account when planning a suitable UPS location and operating environment.

1. The route to the installation location must allow the equipment to be transported in an upright position.
2. The floor at the proposed installation site and en-route from the off-loading point must be able to safely take the weight of the UPS and battery equipment plus fork lift during transit.
3. Locations with high ambient temperature, moisture or humidity must be avoided.
   a) The installation site humidity should be <90% non-condensing.
   b) The prescribed ambient temperature is +15°C to +25°C. An ambient temperature of 20°C is recommended to achieve a long battery life.
   c) Any requested cooling air flow must be available. The air entering the UPS must not exceed +40°C.
   d) The air conditioning system must be able to provide a sufficient amount of cooling air to keep the room within the prescribed temperature range.
4. The following environmental conditions should also be considered:
   a) Fire protection standards must be respected. The floor material should be non-flammable.
   b) The location must be free of dust and corrosive/explosive gases.
   c) The location must be vibration free.
   d) If the UPS is located in bayed enclosures, partition walls must be installed.
   e) The available space must permit the minimum cabinet clearances shown below.

3.5.1 Clearances



Clearance (mm)	X	Y	Z
Minimum	200	200	1000

Figure 3.1 UPS & Battery cabinet clearance requirements

The UPS cabinet requires space to bottom/front and back to enable cooling airflow. Suitable ventilation airflow must be provided *(See Figure 3.1)*.

All parts of the UPS required for maintenance, servicing and user operation are can be accessed from the front of the cabinet; a clearance of 1000mm space should be provided at the front of the UPS cabinet to enable component removal. Cabling is also carried out from the front of the cabinet.

3.6 Planning the installation (cabling considerations)

3.6.1 General requirements

The information in this section should help with the preparation and planning of the UPS power cabling.

It is the customer's responsibility to provide all external fuses, isolators and cables that are used to connect the UPS input and output power supplies. The UPS input and bypass terminals should be connected to the utility mains supply through a suitable LV-Distribution board containing a circuit breaker or fused isolator to provide both overload protection and a means of isolating the UPS from the mains supply when required. Similarly, the UPS output supply terminals should be connected to the load equipment via a suitably fused load distribution board.

Input neutral grounding

A permanently connected input neutral is required to enable the rectifier to operate correctly and allow the UPS to function properly when operating on battery. The input neutral must also be grounded to permit correct operation when the UPS is running on battery.

Key Point: As the input neutral must be unswitched and connected to the UPS at all times. DO NOT use, a 4-pole input switch or isolator at the LV Distribution board on a TN-S system.

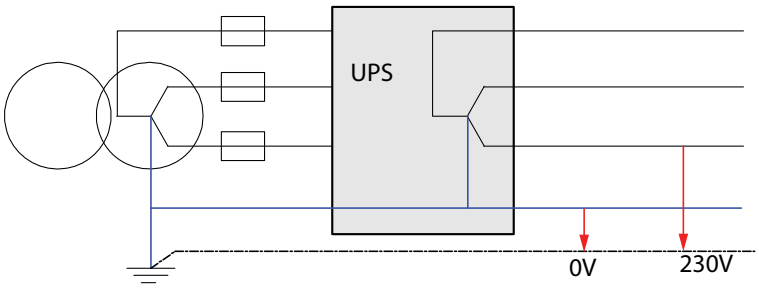


Figure 3.2 Permanent, grounded input neutral

3.6.2 UPS Cable and fuse sizing

Single feed / dual feed inputs

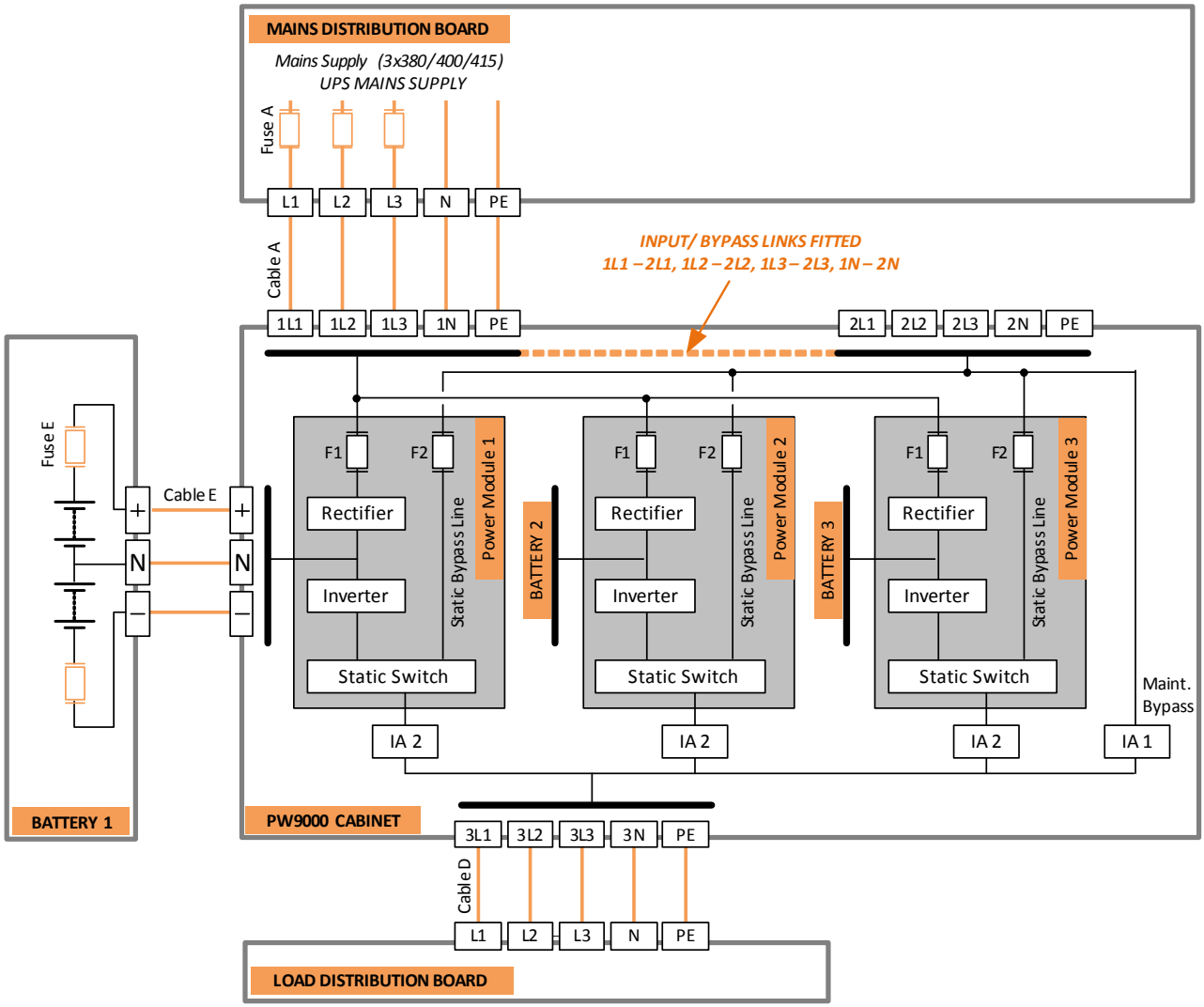
The UPS can be wired for a 'single feed' input (standard), whereby the UPS input supply terminals and bypass supply terminals are internally linked; or it can be wired for a 'dual feed' input, where the bypass links are removed and the UPS bypass terminals are connected to a dedicated 'bypass' supply.

Both configurations are shown in Figure 3.3 (single feed) and Figure 3.4 (dual feed) together with details of the recommended fuse and cable ratings

Key Point: The information in figures 3.3 and 3.4 is given for guidance only:

- Fuse and Cable recommendations are to IEC 60950-1:2001.
- All external fuses, isolators and power cables must be rated and installed in accordance with the prescribed IEC standards or local regulation – e.g. BS7671:2008.
- External DC Cables and battery fuses are bespoke to the installation.

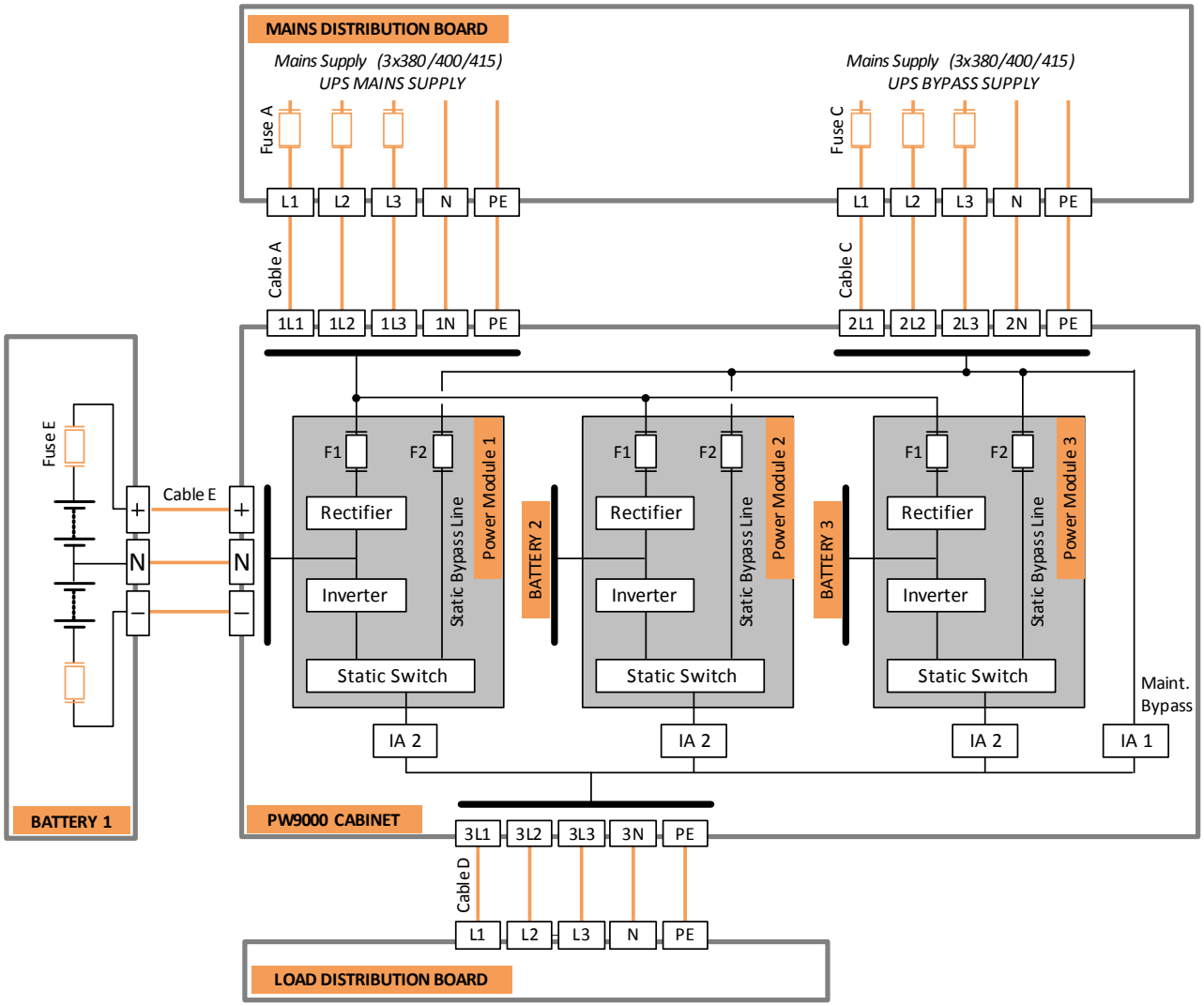
Note: *All cabinets must be cabled according to their full rated output even if the cabinet is not fully populated with power modules at the time of installation. This allows for future expansion to be carries out safely.*



Cabinet (Frame)	Power (kVA)	Single Input (3 x 400V)			Output (3x400V, 0.8 pf)	
		Fuse A (A)	Cable A (mm^2)	Max Input with batt charging (A)	Cable D (mm^2)	Nominal Current (A)
DPA-50	50	3x100	5x25	67	5x25	72
DPA-150	150	3x250	5x120 or 5x(2x50)	202	5x120 or 5x(2x50)	218
DPA-250	250	3x400	5x(2x95)	337	5x(2x95)	362

Note: This illustration shows connections to an external battery cabinet. The DPA-50 and DPA-150 models also contain an internal battery complete with a fused isolator (F4) for each fitted power module.

Figure 3.3 Single input block diagram with recommended cable and fuse sizing



Cabinet (Frame)	Power (kVA)	Dual Input (3 x 400V)				Output (3x400V, 0.8 pf)	
		Fuse B/C (A)	Cable B (mm^2)	Cable C (mm^2)	Max Input with battery charging (A)	Cable D (mm^2)	Nominal Current (A)
DPA-50	80	3x100	5x25	4x25	67	5x25	72
DPA-150	150	3x250	5x120 or 5x(2x50)	4x120 or 4x(2x50)	202	5x120 or 5x(2x50)	218
DPA-250	250	3x400	5x(2x95)	4x(2x95)	337	5x(2x95)	362

Note: This illustration shows connections to an external battery cabinet. The DPA-50 and DPA-150 models also contain an internal battery complete with a fused isolator (F4) for each fitted power module.

Figure 3.4 Dual input block diagram with recommended cable and fuse sizing

3.6.3 UPS Power cable termination sizes

The table below gives details of the cable termination sizes applicable to the various models across the PowerWave 9000 range.

Cabinet (Frame)	Battery	Input*		Output*
	(+ / N / -) +PE	Bypass 3+N	Rectifier 3+N+PE	3+N+PE
DPA-50	DC Fuses and cables are bespoke to the installation.	4 x 16/25mm^2(T)	5 x 16/25mm^2(T)	5 x 16/25mm^2(T)
DPA-150		3 x M10(B) +PE 1xM10 (B)	4 x M10 (B) +PE 1xM10 (B)	4 x M10 (B) +PE 1xM10 (B)
DPA-250		3 x M12 (B) +PE 1xM12 (B)	4 x M12 (B) +PE 1xM12 (B)	4 x M12 (B) +PE 1xM12 (B)
(T) signifies Terminal block. (B) signifies Busbar				

3.6.4 UPS Power connection details

Figures 3.5 to 3.7 illustrate the power terminal connections for the DPA-50, DPA-150 and DPA-250 UPS cabinets respectively. In each case the diagrams depict a single feed input supply with links fitted between the Mains and Bypass input supply terminals. This is the standard configuration and the identified links must be removed for dual feed operation is required.

The diagrams for the DPA-150 and DPA-250 models also show optional links adjacent to the external battery terminal connections. If a common battery is used, these links must be fitted to the terminals shown so that the external battery is connected to all the fitted power modules.

Note: *Best UPS system reliability is achieved when using an independent battery bank for each power module as this extends the module redundancy to include the battery – i.e. when using an independent battery configuration only one power module will be affected in the event of a battery failure.*

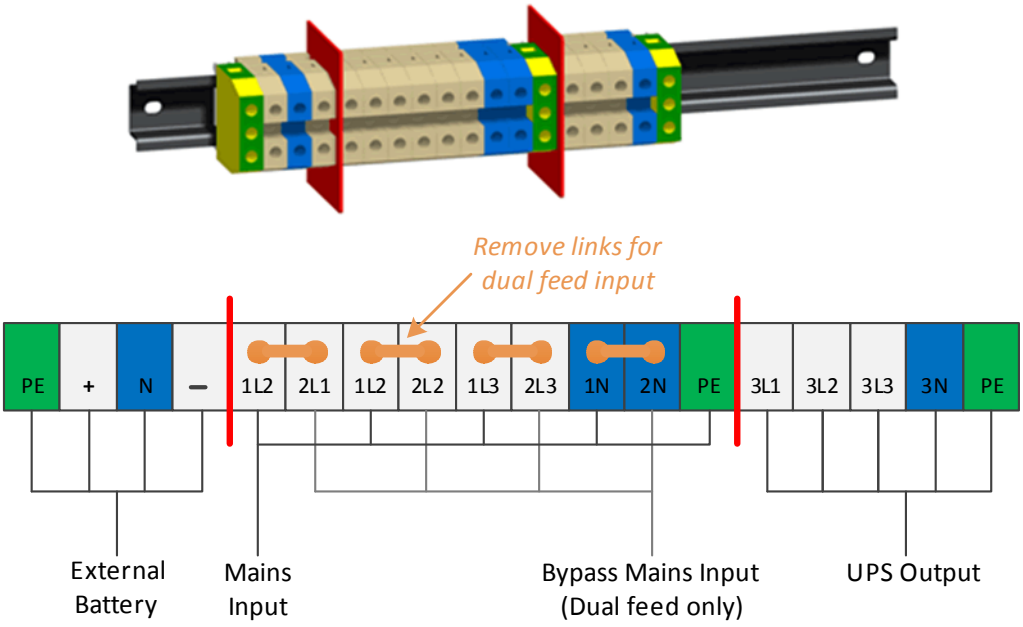


Figure 3.5 DPA-50 Terminal connections

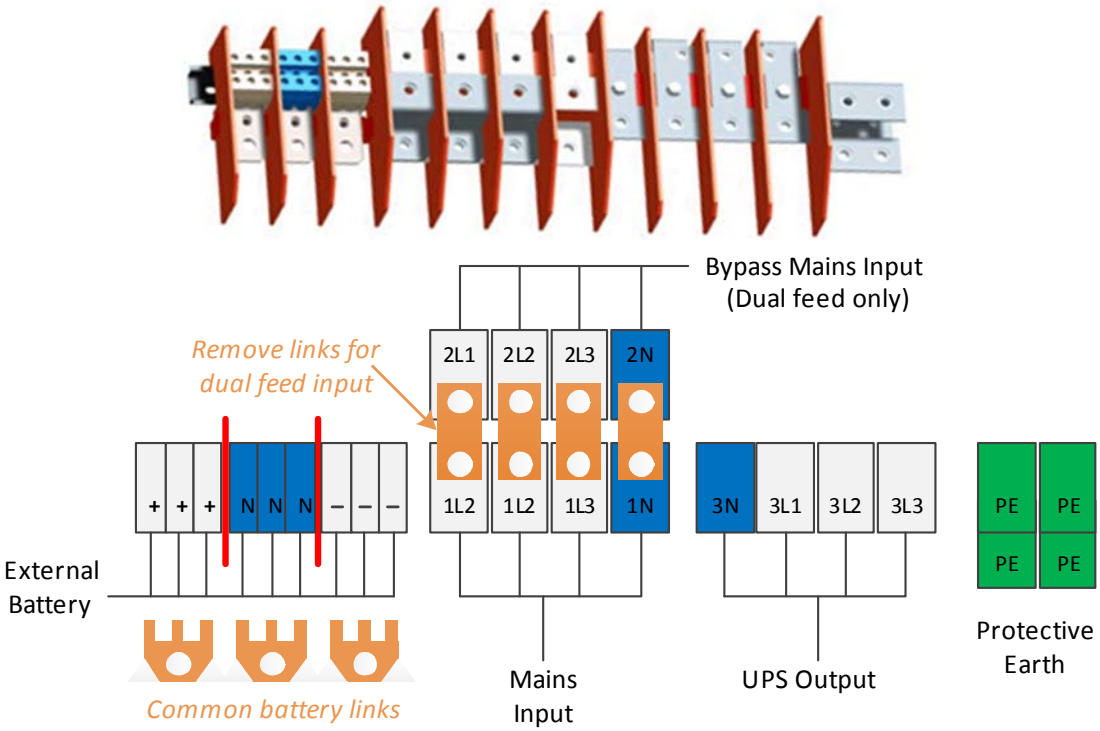


Figure 3.6 DPA-150 Terminal connections

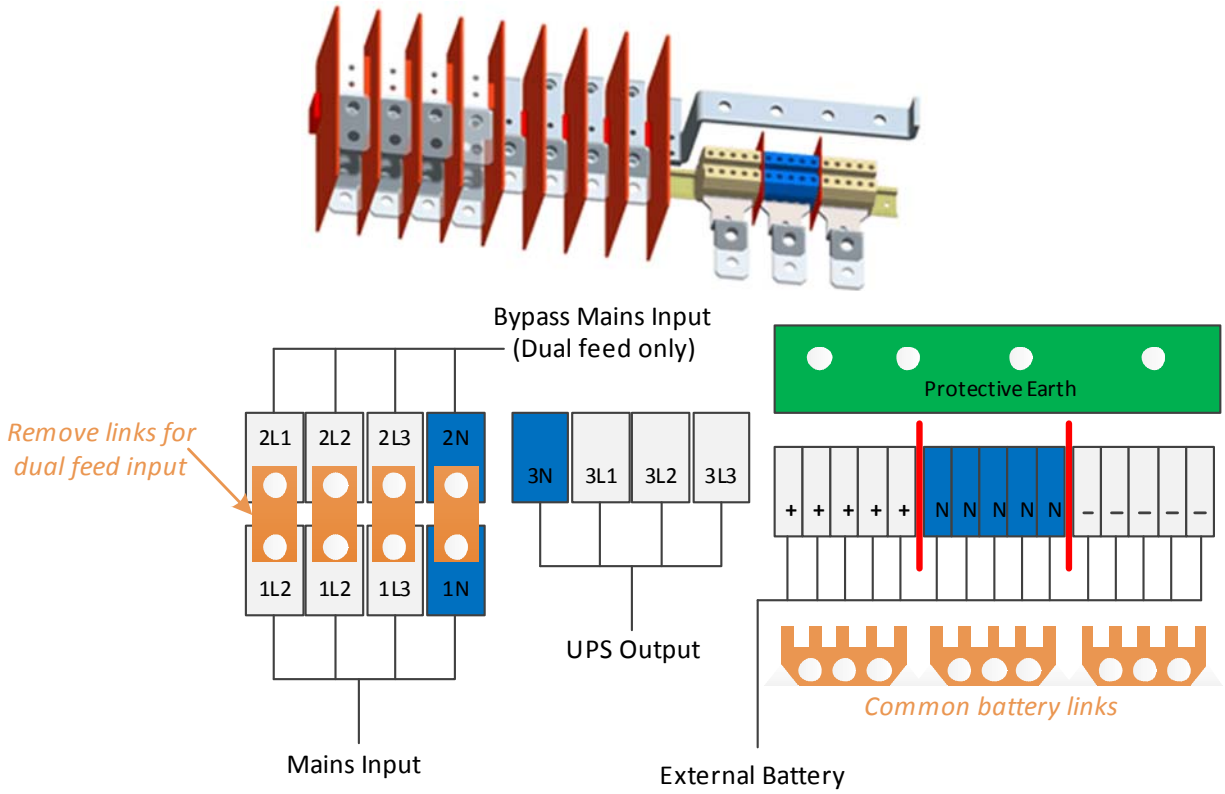
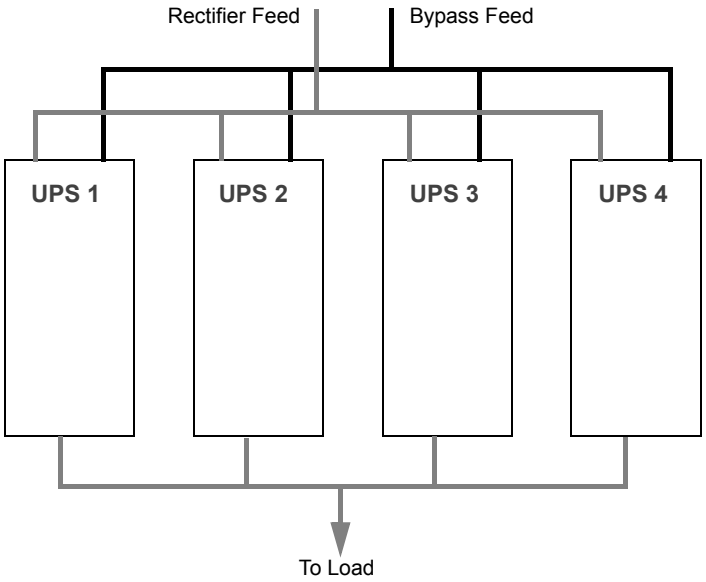


Figure 3.7 DPA-250 Terminal connections

3.6.5 Power cabling in a multi-cabinet installation

In order to achieve equal load sharing between the UPS cabinets in a multi-cabinet installation, the input cables from the input distribution board to each cabinet should be of equal length, as should the UPS output cables to the output distribution board *(See Figure 3.8)*.

Recommended cable configurations



The cable configuration below is not recommended

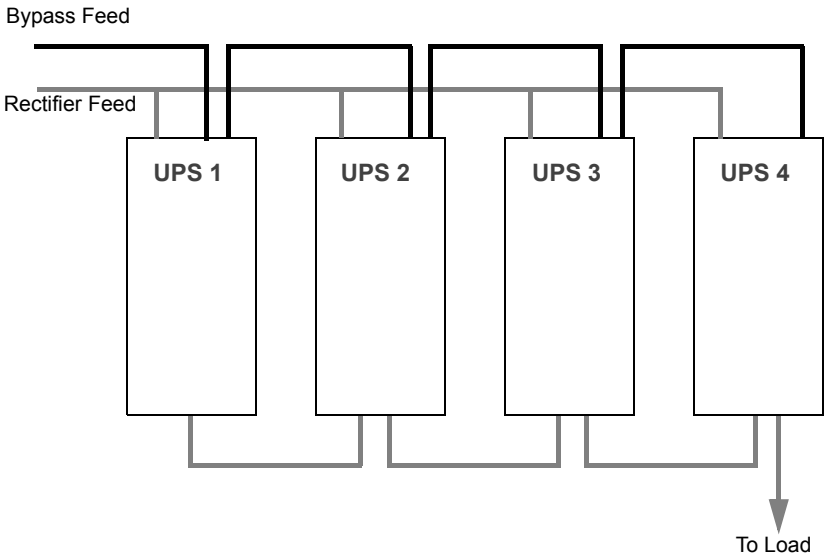


Figure 3.8 Cable lengths for multi-cabinet installation (dual feed input supply shown)

3.6.6 Battery cabling considerations

The PowerWave 9000 UPS battery comprises a number of (30-50) sealed, maintenance-free batteries that are mounted either within the UPS cabinet (DPA-50 & DPA-150) or in an external battery cabinet(s) (DPA-250). An external battery cabinet can also be used in conjunction with the DPA-50 or DPA-150 to increase the available battery autonomy time if required.

A number of battery blocks are connected in series to form a battery string of the required voltage and capacity, and connected to three power terminals annotated '+' '–' and 'N'. The plus and minus connections are taken from the battery string positive and negative extremities, and the 'N' terminal is connected to a point exactly mid-way in the battery string. For this reason the string must comprise an even number of battery blocks.

Battery configuration

Two battery configurations are possible:

- Common battery – where all the power modules are connected to the same battery source (although that source may itself comprise several battery strings connected in parallel). This requires 'common battery' links to be fitted to the UPS battery power terminals, as shown below.
- Individual battery – where each module is connected to an individual battery string.

These configurations are illustrated in Figure 3.9, which shows the alternative connections for internal batteries in a DPA-150 cabinet fitted with three power modules. Figure 3.10 shows an example of the alternative connections when using an external battery cabinet shown connected to a DPA-250 (5 module) cabinet.

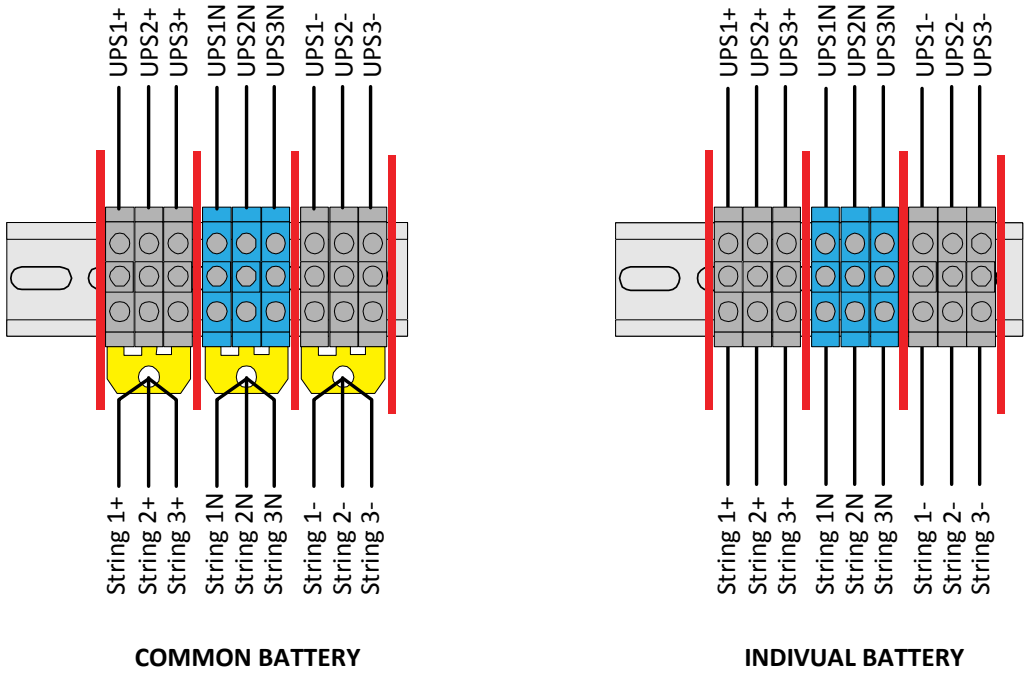
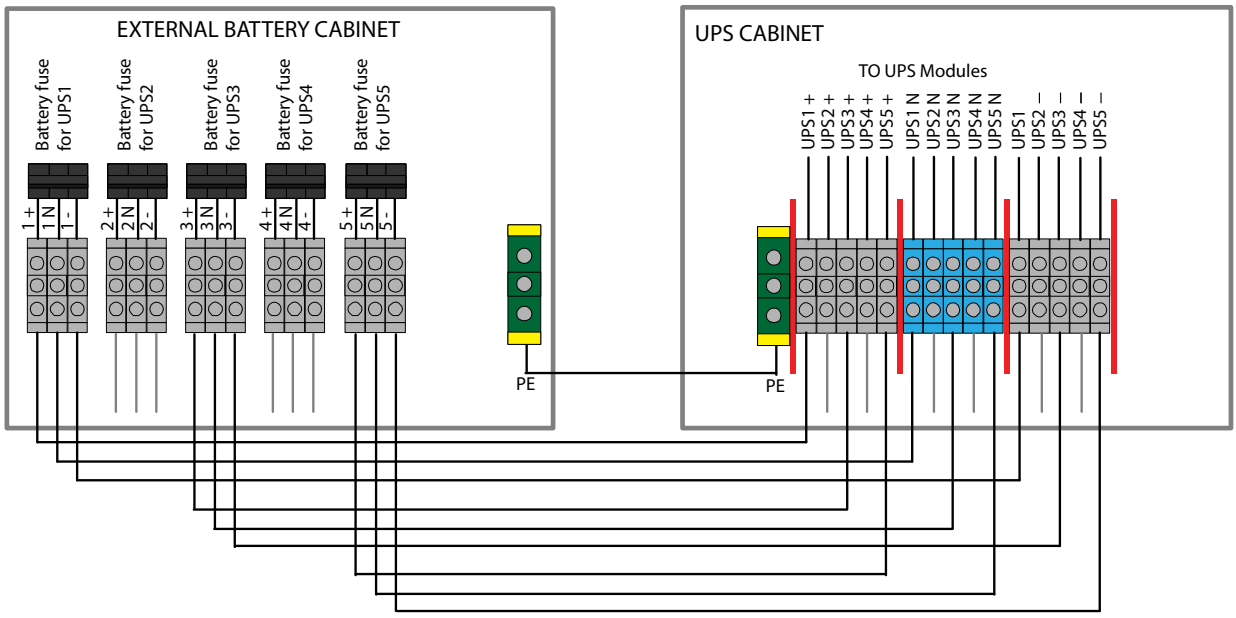


Figure 3.9 Internal battery connections (3-module UPS cabinet shown)


EXTERNAL BATTERY CABINET
Battery fuse for UPS1
Battery fuse for UPS2
Battery fuse for UPS3
Battery fuse for UPS4
Battery fuse for UPS5
1+ 1N 1-
2+ 2N 2-
3+ 3N 3-
4+ 4N 4-
5+ 5N 5-
PE
UPS CABINET
TO UPS Modules
UPS1 + UPS2 + UPS3 + UPS4 + UPS5 +
UPS1 N UPS2 N UPS3 N UPS4 N UPS5 N
UPS1 – UPS2 – UPS3 – UPS4 – UPS5 –
PE

For reasons of clarity, the wiring for modules 1,3,5 only is shown in detail

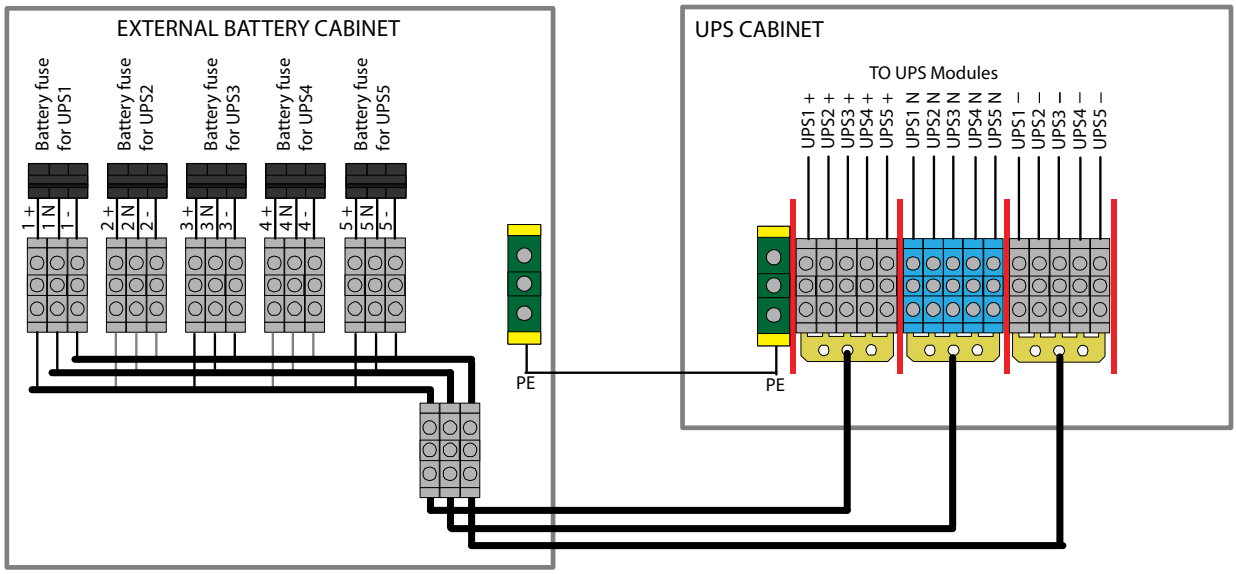

EXTERNAL BATTERY CABINET
Battery fuse for UPS1
Battery fuse for UPS2
Battery fuse for UPS3
Battery fuse for UPS4
Battery fuse for UPS5
1+ 1N 1-
2+ 2N 2-
3+ 3N 3-
4+ 4N 4-
5+ 5N 5-
PE
UPS CABINET
TO UPS Modules
UPS1 + UPS2 + UPS3 + UPS4 + UPS5 +
UPS1 N UPS2 N UPS3 N UPS4 N UPS5 N
UPS1 – UPS2 – UPS3 – UPS4 – UPS5 –
PE

Figure 3.10 External battery cabinet wiring (5-module UPS cabinet shown)

Internal battery installations

DPA-50

A DPA-50 cabinet contains a single UPS power module and can accommodate up to 280 x 7Ah internal batteries. Figure 3.11 shows the different battery configurations.

	A	B	C	D
	UPS Module			
7	10x7Ah		10x7Ah	
6	10x7Ah	2x5x7Ah	10x7Ah	
5	10x7Ah	10x7Ah	10x7Ah	10x7Ah
4	10x7Ah	2x5x7Ah	10x7Ah	10x7Ah
3	2x5x7Ah	2x5x7Ah	2x5x7Ah	2x5x7Ah
2	10x7Ah	10x7Ah	10x7Ah	10x7Ah
1	10x7Ah	10x7Ah	10x7Ah	10x7Ah

(5x50) x7Ah

A	B	C	D
UPS Module			
10x7Ah	10x7Ah	10x7Ah	10x7Ah
10x7Ah	10x7Ah	10x7Ah	10x7Ah
2x5x7Ah	2x5x7Ah	2x5x7Ah	2x5x7Ah
10x7Ah	10x7Ah	10x7Ah	10x7Ah
10x7Ah	10x7Ah	10x7Ah	10x7Ah

(4x50) x7Ah

A	B	C	D
UPS Module			
10x7Ah	10x7Ah	10x7Ah	
10x7Ah	10x7Ah	10x7Ah	
10x7Ah	10x7Ah	10x7Ah	
10x7Ah	10x7Ah	10x7Ah	

(3x40) x7Ah

Figure 3.11 DPA-50 Battery configurations

DPA-150

A DPA-150 cabinet can contain up to three UPS power modules and has space for up to 240 x 7Ah internal batteries. Figure 3.12 shows the full battery configuration. Each vertical block of batteries can be wired as an individual string for each power module, or connected as three parallel strings to provide a common battery for all three modules.

	A	B	C
	UPS Module 3		
	UPS Module 2		
	UPS Module 1		
6	10x7Ah	10x7Ah	10x7Ah
5	10x7Ah	10x7Ah	10x7Ah
4	10x7Ah	10x7Ah	10x7Ah
3	10x7Ah	10x7Ah	10x7Ah
2	10x7Ah	10x7Ah	10x7Ah
1	10x7Ah	10x7Ah	10x7Ah

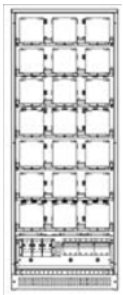
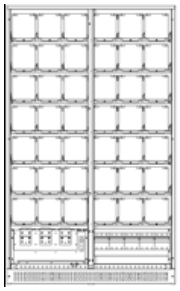
3x(2x40)x7Ah

Figure 3.12 DPA-150 Battery configurations

External battery installations

Two matching external battery cabinets are available:

- CBAT DPA-120 for battery configurations of 24Ah or 28Ah blocks (max. 120 Blocks)
- CBAT DPA-200 for battery configurations for 24Ah or 28Ah blocks (max. 200 Blocks)

S-type = For Separate Battery C-type = For Common Battery		**CBAT-DPA-120** S-type = item no. 00-7912 C-type = item no. 00-7964	**CBAT-DPA-200** S-type = item no. 00-7913 C-type = item no. 00-7965
BATTERY FRAMES			
Configuration accommodates:	Max.	120 Batt. block x 24Ah/28Ah on 8 shelves 3x5=15 blocks/shelf	200 Batt. blocks x 24Ah/28Ah on 7 shelves 6x5=30 blocks/shelf
Battery fuses / Max. Batt. Strings Terminals:	S-type	3 / 3 (Terminal 9 x 16/25mm^2)	5 / 5 (Terminal 15 x 16/25mm^2)
Battery fuses / Max. Batt. Strings Terminals:	C-type	3 / 3 + Com. Connection Bar 3 x (2xM8) +PE 2xM8	5 / 5 + Com. Connection Bar 3 x (2xM10) +PE 2xM10
Fuse Type (Very Fast acting)	A	3x100 A *	5x100A *
Dimensions (WxHxD)	mm	730x1975x800	1200x1975x800
Weight w/o trays and w/o batteries	kg	150	250
Note: Battery fuses and cables are bespoke to the installation. The above are recommendations only, all fuses and cables must comply with prescribed IEC standards or local regulations.			

CBAT DPA-120

	A	B	C
8	5x28Ah	5x28Ah	5x28Ah
7	5x28Ah	5x28Ah	5x28Ah
6	5x28Ah	5x28Ah	5x28Ah
5	5x28Ah	5x28Ah	5x28Ah
4	5x28Ah	5x28Ah	5x28Ah
3	5x28Ah	5x28Ah	5x28Ah
2	5x28Ah	5x28Ah	5x28Ah
1	5x28Ah	5x28Ah	5x28Ah

(3x40)x28Ah

CBAT DPA-200

A	B	C	D	E	F
5x28Ah	5x28Ah	5x28Ah	5x28Ah	5x28Ah	5x28Ah
5x28Ah	5x28Ah	5x28Ah	5x28Ah	5x28Ah	5x28Ah
5x28Ah	5x28Ah	5x28Ah	5x28Ah	5x28Ah	5x28Ah
5x28Ah	5x28Ah	5x28Ah	5x28Ah	5x28Ah	5x28Ah
5x28Ah	5x28Ah	5x28Ah	5x28Ah	5x28Ah	5x28Ah
5x28Ah	5x28Ah	5x28Ah	5x28Ah	5x28Ah	5x28Ah
5x28Ah	5x28Ah	5x28Ah		5x28Ah	5x28Ah
5x28Ah	5x28Ah	5x28Ah		5x28Ah	5x28Ah

(4x50)x28Ah

Figure 3.13 External battery cabinet configurations

3.7 UPS Cabling procedure

WARNING: Opening or removing the UPS-covers will create a risk of exposure to dangerous voltages if power is connected to the UPS.

Safety notes

Please ensure you read and understand the following safety notes before you begin the UPS electrical installation.

1. Do not commence this procedure until the UPS mechanical installation is completed.
2. All the cable installation procedures detailed below must be supervised by a qualified electrician.
3. Do not connect or operate the UPS if there is water or moisture present.
4. When carrying out any work on the UPS power cables or terminals, you must ensure that the UPS input and load supplies are isolated and locked out at their respective distribution boards. Warning notices should be posted to prevent any inadvertent operation of the UPS mains supply isolators.
5. Before you connect the UPS input cables ensure that the customer-provided fuses and cables are suitably rated in accordance with the prescribed IEC standards or local regulations (for example BS7671:2008) – see figures 3.3 and 3.4 for guidance.
6. Once the electrical installation is completed the UPS must be commissioned by an engineer authorised by the manufacturer before it is brought into use.

WARNING: Do not apply electrical power to the UPS before it has been commissioned.

7. When installing the UPS cables ensure that the connection procedures are performed under the following conditions:
   a) No mains voltage is present at the UPS mains (or bypass) distribution board terminals.
   b) All loads are disconnected at the load distribution board.
   c) The UPS is fully shut down and voltage-free.
   d) The UPS Maintenance Bypass Isolator IA1 is open (OFF).
   e) The UPS Parallel Isolator IA2 is open (OFF) (for all fitted modules).

3.7.1 Connecting the input cables

Refer to figures 3.5 to 3.7 *(also figures 3.14 to 3.16)*

1. Gain full access to the UPS power terminals by removing the aluminium panel at the bottom of the UPS, below the switch-gear.
2. Connect the earth cable from the mains distribution board to the UPS protective earth terminal (PE).

Single input feed (standard)

3. Refer to the schematic drawing and connection table in Figure 3.3.
4. Connect the UPS input supply cables to the UPS input power terminals 1L1, 1L2, 1L3 and 1N. Ensure correct (clockwise) phase rotation.

CAUTION: *The input Neutral cable must be unswitched and ALWAYS connected.*

5. Secure the cables to the fixing rail under the connection terminals.

Dual input feed

6. Refer to the schematic drawing and connection table in Figure 3.4.
7. The UPS is supplied for single feed input as standard. For a dual feed configuration remove the links between the UPS power terminals 1L1-2L1, 1L2-2L2, 1L3-2L3 and 1N-2N.

8. Connect the UPS input supply cables to the UPS power terminals 1L1, 1L2, 1L3 and 1N. Ensure correct (clockwise) phase rotation.

CAUTION: *The input Neutral cable must ALWAYS be connected.*

9. Connect the earth cable from the bypass mains distribution board to the UPS cabinet's protective earth (PE) terminal.
10. Connect the UPS bypass mains supply cables to the UPS bypass power terminals 2L1, 2L2, 2L3 and 2N. Ensure correct (clockwise) phase rotation.

CAUTION: *The bypass Neutral cable must ALWAYS be connected.*

11. Secure the cables to the fixing rail under the connection terminals.

Note: *The UPS commissioning engineer will re-configure the UPS electronics to operated with a dual feed input at the time of commissioning.*

3.7.2 Connecting the UPS output cables

It is recommended that a separate load distribution board is provided for the load.

Before you begin connecting the UPS output cables to the load distribution board:

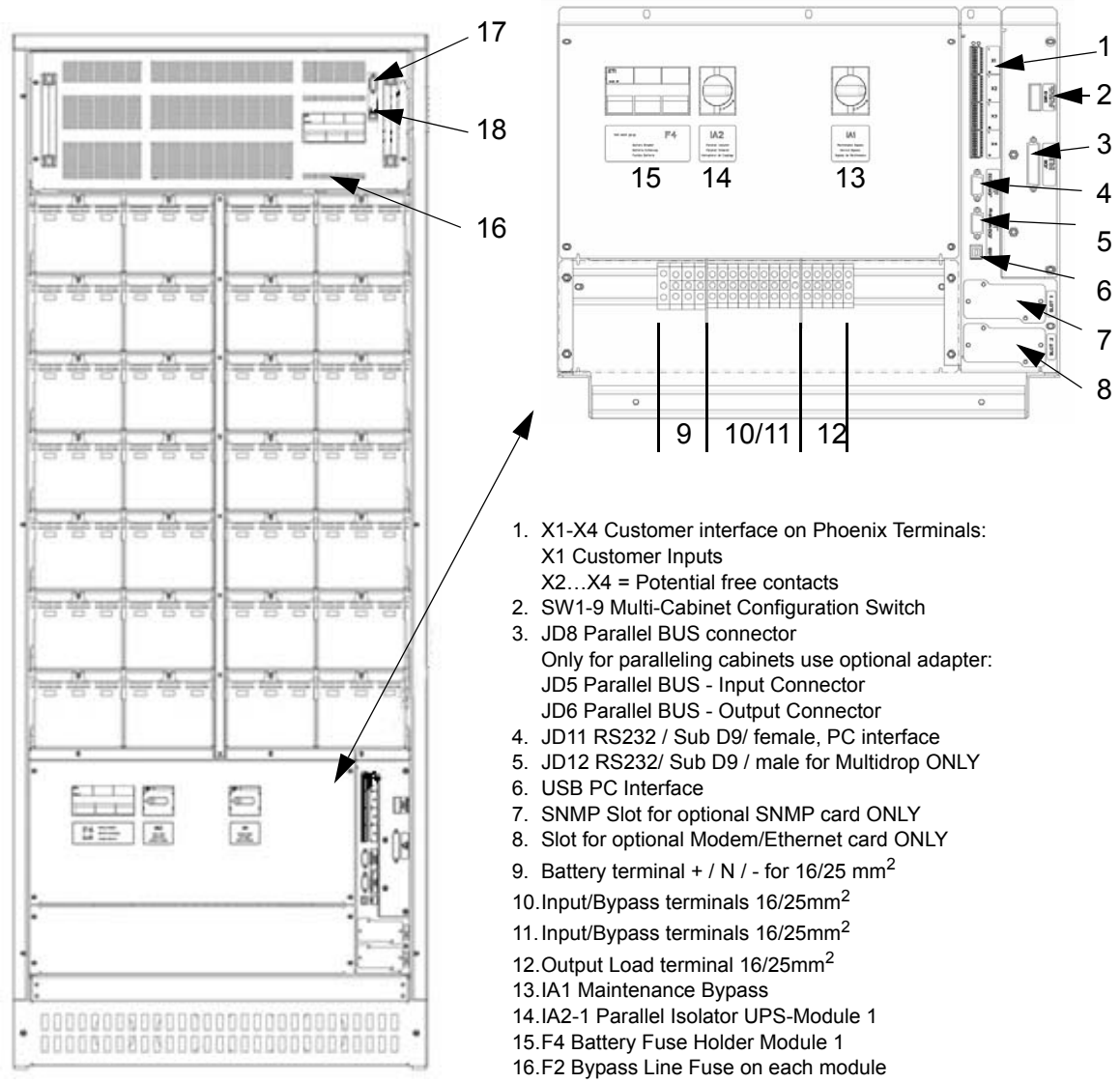
- Check that the potential full load does not exceed the UPS output power rating (OUTPUT POWER on the nameplate).
- Ensure the load circuit breakers on the load distribution board are correctly sized with respect to the load rating and associated cabling.
- Ensure that the maximum total load rating, and maximum load rating of each individual load socket, is indicated on the load distribution board.

The circuit breakers must comply with the prescribed IEC Standards (e.g. BS7671:2008).

1. Gain full access to the UPS power terminals by removing the aluminium panel at the bottom of the UPS, below the switch-gear.
2. Connect the protective earth cable from the load distribution board to the UPS cabinet's protective earth (PE) terminal.
3. Connect the UPS output supply cables to the UPS output power terminals 3L1, 3L2, 3L3 and 3N. Ensure correct (clockwise) phase rotation.

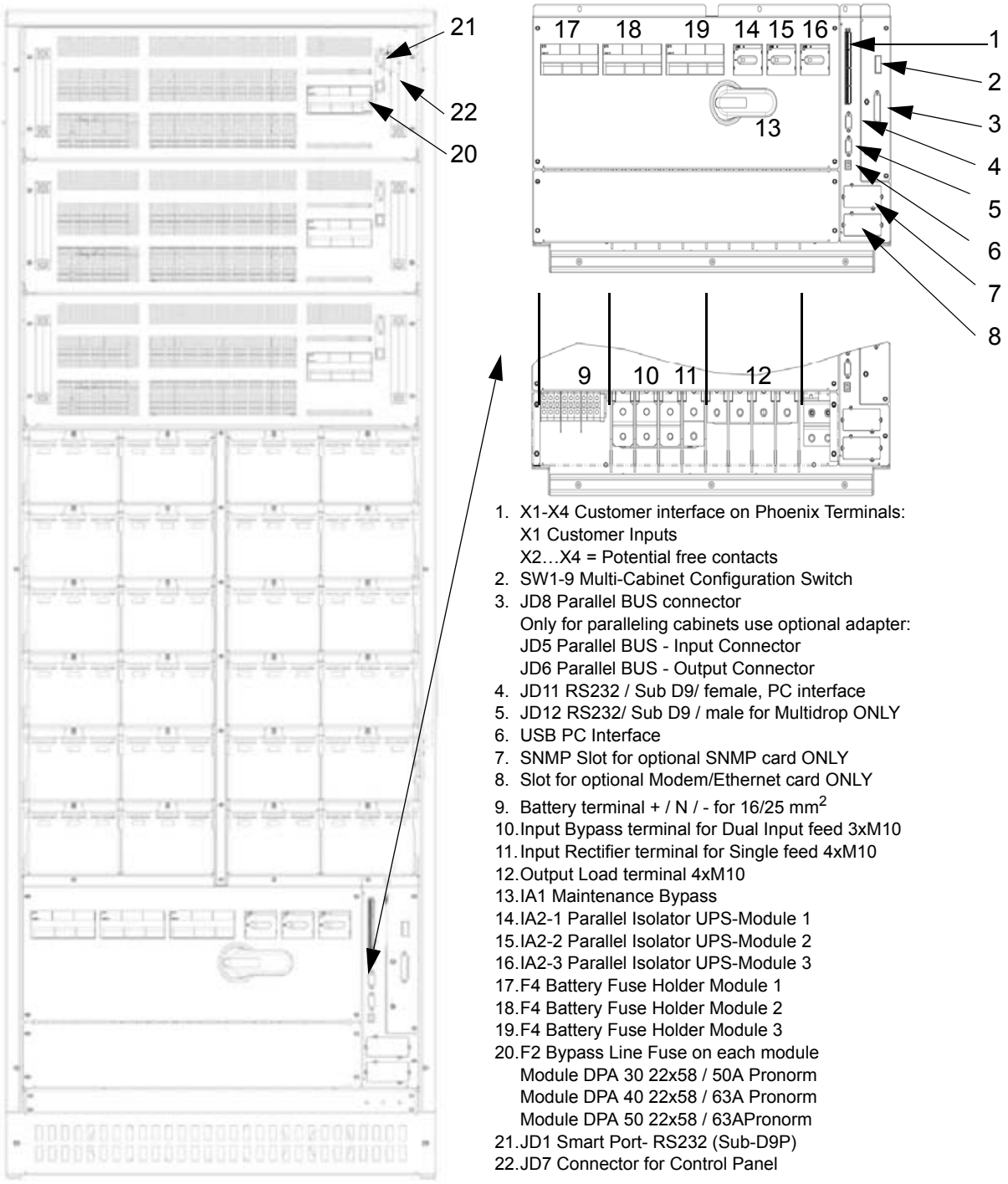
CAUTION: *The output Neutral cable must ALWAYS be connected.*

4. Secure the cables to the fixing rail located under the UPS connection terminals.
5. Ensure the output cables are connected to the correct power terminals on the load distribution board.



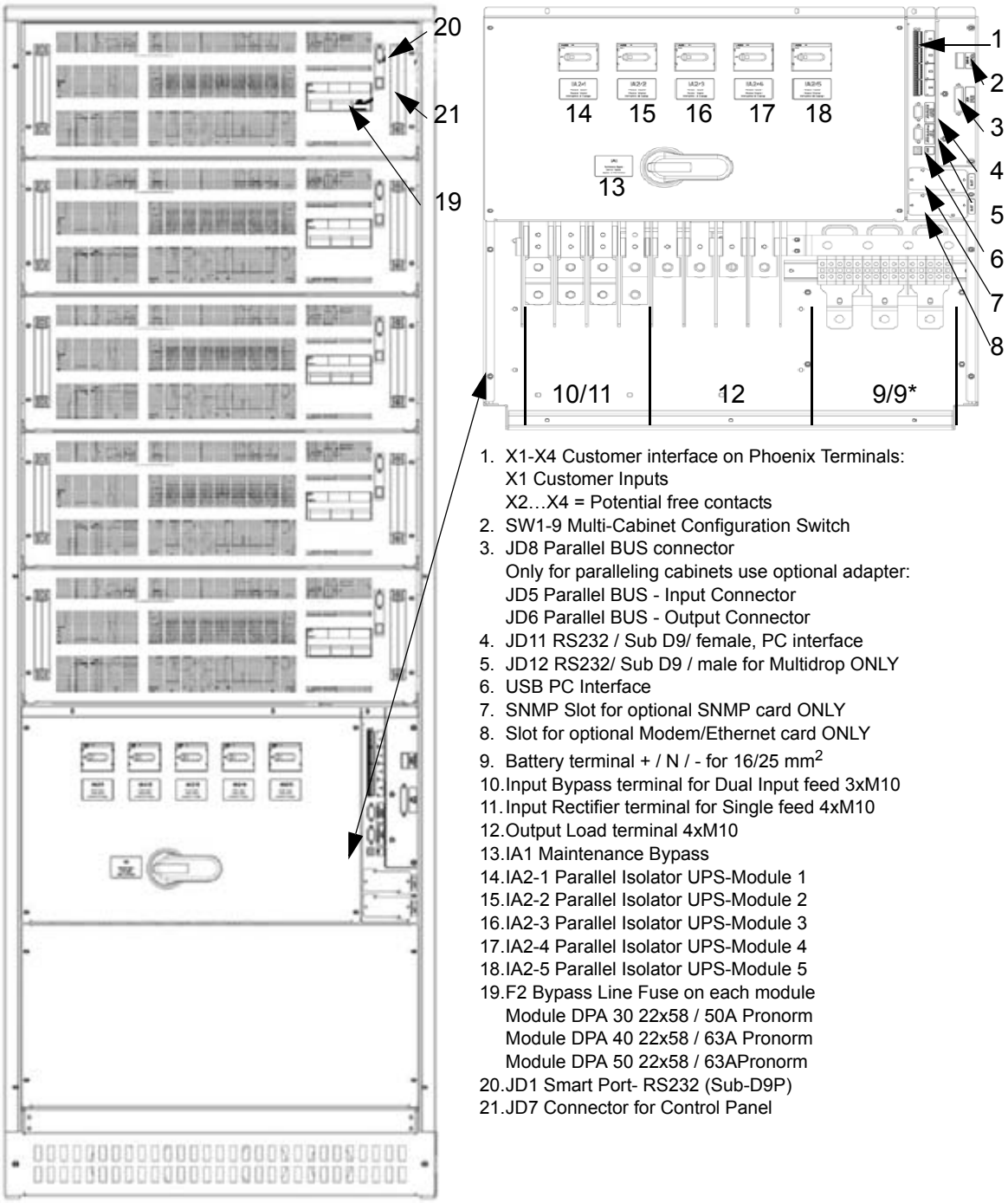
1. X1-X4 Customer interface on Phoenix Terminals:
   X1 Customer Inputs
   X2…X4 = Potential free contacts
2. SW1-9 Multi-Cabinet Configuration Switch
3. JD8 Parallel BUS connector
   Only for paralleling cabinets use optional adapter:
   JD5 Parallel BUS - Input Connector
   JD6 Parallel BUS - Output Connector
4. JD11 RS232 / Sub D9/ female, PC interface
5. JD12 RS232/ Sub D9 / male for Multidrop ONLY
6. USB PC Interface
7. SNMP Slot for optional SNMP card ONLY
8. Slot for optional Modem/Ethernet card ONLY
9. Battery terminal + / N / - for 16/25 mm^2
10. Input/Bypass terminals 16/25mm^2
11. Input/Bypass terminals 16/25mm^2
12. Output Load terminal 16/25mm^2
13. IA1 Maintenance Bypass
14. IA2-1 Parallel Isolator UPS-Module 1
15. F4 Battery Fuse Holder Module 1
16. F2 Bypass Line Fuse on each module
    Module DPA 30 22x58 / 50A Pronorm
    Module DPA 40 22x58 / 63A Pronorm
    Module DPA 50 22x58 / 63APronorm
17. JD1 Smart Port- RS232 (Sub-D9P)
18. JD7 Connector for Control Panel

Figure 3.14 DPA-50 Input/output terminal block, front view



1. X1-X4 Customer interface on Phoenix Terminals:
   X1 Customer Inputs
   X2…X4 = Potential free contacts
2. SW1-9 Multi-Cabinet Configuration Switch
3. JD8 Parallel BUS connector
   Only for paralleling cabinets use optional adapter:
   JD5 Parallel BUS - Input Connector
   JD6 Parallel BUS - Output Connector
4. JD11 RS232 / Sub D9/ female, PC interface
5. JD12 RS232/ Sub D9 / male for Multidrop ONLY
6. USB PC Interface
7. SNMP Slot for optional SNMP card ONLY
8. Slot for optional Modem/Ethernet card ONLY
9. Battery terminal + / N / - for 16/25 mm^2
10. Input Bypass terminal for Dual Input feed 3xM10
11. Input Rectifier terminal for Single feed 4xM10
12. Output Load terminal 4xM10
13. IA1 Maintenance Bypass
14. IA2-1 Parallel Isolator UPS-Module 1
15. IA2-2 Parallel Isolator UPS-Module 2
16. IA2-3 Parallel Isolator UPS-Module 3
17. F4 Battery Fuse Holder Module 1
18. F4 Battery Fuse Holder Module 2
19. F4 Battery Fuse Holder Module 3
20. F2 Bypass Line Fuse on each module
    Module DPA 30 22x58 / 50A Pronorm
    Module DPA 40 22x58 / 63A Pronorm
    Module DPA 50 22x58 / 63APronorm
21. JD1 Smart Port- RS232 (Sub-D9P)
22. JD7 Connector for Control Panel

Figure 3.15 DPA-150 Input/output terminal block, front view



1. X1-X4 Customer interface on Phoenix Terminals:
   X1 Customer Inputs
   X2…X4 = Potential free contacts
2. SW1-9 Multi-Cabinet Configuration Switch
3. JD8 Parallel BUS connector
   Only for paralleling cabinets use optional adapter:
   JD5 Parallel BUS - Input Connector
   JD6 Parallel BUS - Output Connector
4. JD11 RS232 / Sub D9/ female, PC interface
5. JD12 RS232/ Sub D9 / male for Multidrop ONLY
6. USB PC Interface
7. SNMP Slot for optional SNMP card ONLY
8. Slot for optional Modem/Ethernet card ONLY
9. Battery terminal + / N / - for 16/25 mm^2
10. Input Bypass terminal for Dual Input feed 3xM10
11. Input Rectifier terminal for Single feed 4xM10
12. Output Load terminal 4xM10
13. IA1 Maintenance Bypass
14. IA2-1 Parallel Isolator UPS-Module 1
15. IA2-2 Parallel Isolator UPS-Module 2
16. IA2-3 Parallel Isolator UPS-Module 3
17. IA2-4 Parallel Isolator UPS-Module 4
18. IA2-5 Parallel Isolator UPS-Module 5
19. F2 Bypass Line Fuse on each module
    Module DPA 30 22x58 / 50A Pronorm
    Module DPA 40 22x58 / 63A Pronorm
    Module DPA 50 22x58 / 63APronorm
20. JD1 Smart Port- RS232 (Sub-D9P)
21. JD7 Connector for Control Panel

Figure 3.16 DPA-250 Input/output terminal block, front view

3.8 Battery cabling procedure

Safety Notes

WARNING: Opening or removing the UPS/Battery enclosure covers will create the risk of exposure to dangerous voltages if power is connected to the UPS.

If the UPS is delivered without batteries, Uninterruptible Power Supplies Ltd is not responsible for any damage or malfunction caused to the UPS by the incorrect storage, installation or connection of batteries by third parties.

The final assembly and battery connection must be supervised by the commissioning engineer. Do not attempt to complete the battery wiring or close the battery isolators before the system has been commissioned.

Please ensure you read and understand the following safety notes before you begin the battery installation.

1. All the cable installation procedures detailed below must be supervised by the commissioning engineer.
2. Ensure that the UPS input and output supplies are isolated and locked out at their respective distribution boards. Warning notices should be posted to prevent any inadvertent operation of the UPS mains supply isolators.
3. External battery cables and fuses are bespoke to the installation. Before you connect the battery cables ensure that the customer-provided fuses and cables are suitably rated in accordance with the prescribed IEC standards or local regulations (for example BS7671:2008).
4. Ensure that the UPS maintenance bypass switch (IA1).
5. Ensure that the UPS fused battery isolator(s) (F4) is open (DPA-50 & DPA-150) and the battery isolators are open in the external battery cabinet (DPA-250 or where used) – the terminals to which the battery cables are to be fitted must be electrically isolated.

3.8.1 Connecting the battery cables

***Note:** The battery cables and fuses are bespoke to the installation.*

UPS Cabinet mounted batteries

Internally mounted batteries will be connected by the commissioning engineer.

External battery cabinet mounted batteries

The batteries within the external battery cabinet will be connected by the commissioning engineer. The only wiring that can be carried out by the installation engineer is the cabling between the external battery cabinet and the UPS battery terminal blocks, as detailed below:

1. Familiarise yourself with the wiring diagrams in Figure 3.10 and determine whether the installation is designed to use a common battery or individual battery
2. Ensure that the fused battery isolator(s) in the external battery cabinet are open.

WARNING: Do not re-close the fused battery isolators in the battery cabinet before the UPS system is commissioned.

3. Connect the protective earth cable (PE) between the UPS and external battery cabinet.
4. Connect the battery cables, from the UPS battery terminal blocks to the corresponding battery terminal blocks in the external cabinet, ensuring that the cables are connected to the corresponding + / N /- terminals as illustrated in Figure 3.10.

3.9 Multi-cabinet configuration and paralleling cables

Key Point: This section is required only if two (or more) cabinets are to be connected in a multi-cabinet parallel configuration, as described paragraph 2.3.3.

In a multi-cabinet system a series of communication bus cables must be connected between each cabinet to enable various parallel control functions to operate. Each module must also be configured to identify its position within the parallel system – e.g 'first', 'middle' or 'last' module. The module set up to be the 'first' module in the chain acts as the 'master' module in relation to the inter-module parallel control logic.

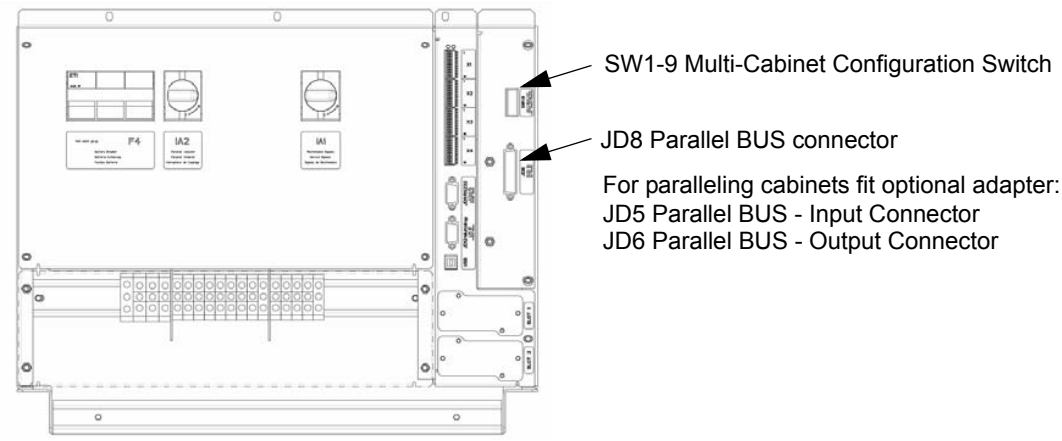

SW1-9 Multi-Cabinet Configuration Switch
JD8 Parallel BUS connector
For paralleling cabinets fit optional adapter:
JD5 Parallel BUS - Input Connector
JD6 Parallel BUS - Output Connector

Figure 3.17 Cabinet interface board

WARNING: Before making the following connections ensure that all the UPS cabinets are powered down and all parallel isolators (IA2) are open.

Setting the configuration DIP Switch SW1-9

DIP Switch SW1-9, located on the UPS interface board (see Figure 3.17), is used to configure the position of the cabinet in the parallel UPS chain. Using this switch you can define the cabinet's position as:

- the *first* ('master') cabinet in the chain (e.g. *cabinet 1* in Figure 3.18).
- the *middle* cabinet in the chain (there may be more than one *middle* cabinet).
- the *last* cabinet in the chain (e.g. *cabinet n* in Figure 3.18).

1. Set DIP Switch SW1-9 of each cabinet according to the table below:

	First UPS	Middle UPS	Last UPS	Single UPS
SW 1a 1	ON	OFF	ON	ON
SW 1b 2	OFF	OFF	ON	ON
SW 1c 3	ON	OFF	OFF	ON
SW 1d 4	ON	OFF	ON	ON
SW 1e 5	ON	OFF	ON	ON
SW 1f 6	ON	OFF	ON	ON
SW 1g 7	ON	OFF	ON	ON
SW 1h 8	ON	OFF	ON	ON
SW 1i 9	ON	OFF	ON	ON

Connecting the parallel cabinet control cables

2. Fit a parallel adaptor board over the connector JD8 on the interface board (Figure 3.17) in every UPS cabinet.

   Note: *The parallel adapter contains two port connectors, JD5 and JD6 and a configuration DIP Switch (SW2) (see Figure 3.18).*

3. Connect JD6 of the parallel adapter in UPS Cabinet 1 to JD5 of the parallel adapter in Cabinet 2 using the corresponding bus-cable (supplied).
4. Similarly, connect JD6 of the parallel adaptor in UPS Cabinet 2 to JD5 in Cabinet 3.
5. Continue in the same manner for the remaining UPS Cabinets, as illustrated in Figure 3.18.

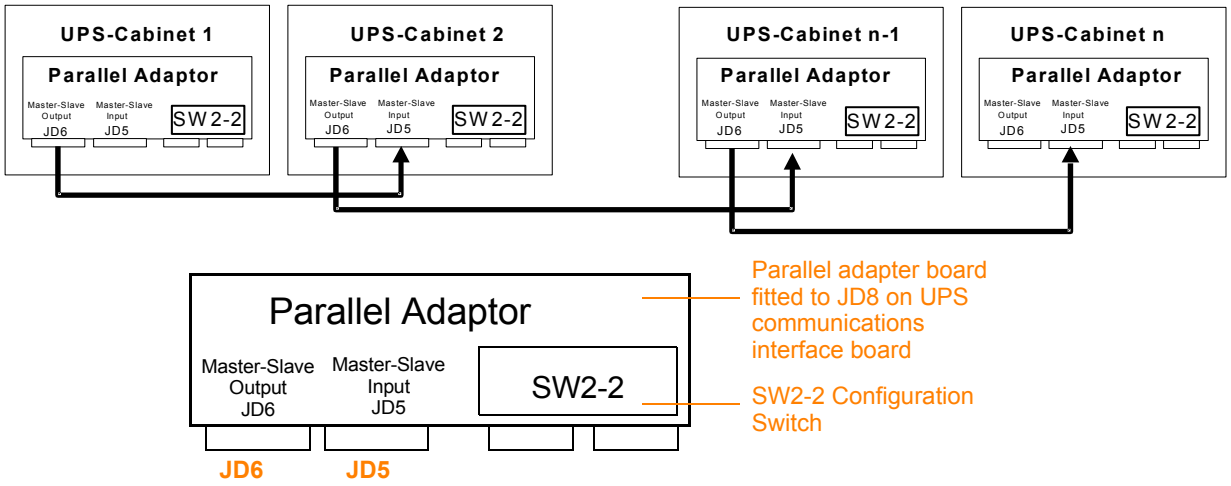
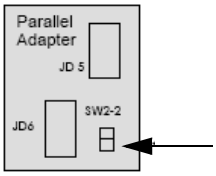


Figure 3.18 Connection of the Bus-lines when paralleling UPS-Cabinet Parallel Adaptors

Setting the configuration DIP Switch SW2-2

6. Set the configuration DIP Switch SW2-2 on each parallel adapter according to the position of the particular UPS Cabinet in the parallel system (as previously set by SW1-9 above).



	Single Unit	First Unit	Middle Unit	Last Unit
SW1	ON	OFF	OFF	ON
SW2	ON	ON	OFF	OFF

Figure 3.19 Configuration DIP Switch SW2-2

3.10 Optional remote monitoring and control facilities

In addition to the paralleling facilities described above, the interface board also contains various input/output connections that can be used with a number of optional external monitoring and control devices. These are described in Chapter 7.

4 Operation

4.1 Introduction

The PowerWave 9000 UPS system must be commissioned by a fully trained field service engineer authorised by Uninterruptible Power Supplies Ltd before it is put into use.

The commissioning engineer will:

- Connect the UPS batteries.
- Check the UPS electrical installation and operating environment.
- Check the UPS cabinet paralleling configuration settings.
- Check the installation of any optional equipment.
- Perform a controlled UPS start-up and functionally test the system for correct operation and configuration.
- Carry out customer operator training and equipment handover.

WARNING: Uninterruptible Power Supplies Ltd. accepts no responsibility for the equipment or the safety of any personnel when operating this equipment before it has been properly commissioned.

The manufacturer's warranty is immediately invalidated if power is applied to any part of the UPS system before it has been fully commissioned and handed over to the customer.

4.1.1 Operating procedure summary

Under normal circumstances all the UPS modules in a multi-module system are running and operating in their 'on-line' (on inverter) mode. If a module fails, in a redundant module system the faulty module will shut down but will not affect the remaining on-line modules, which will continue to supply the load with processed power. The failed module can then be replaced or tested off-line without affecting the remaining working modules.

If a UPS module fails in a capacity (or single module) system, the faulty module is shut-down and the load is immediately transferred to the static bypass supply (in all modules) from where it is supplied with unprotected mains power.

The UPS cabinet contains a maintenance bypass switch which, when closed, completely bypasses the UPS modules and connects the cabinet output terminals directly to its bypass mains input. When operating via the maintenance bypass switch, the UPS modules can be replaced or tested off-line as required. In the case of a single module installation the load must be transferred to the maintenance bypass to maintain the load power while the UPS module is replaced.

***Note:** All the switches and control panel operations mentioned in this chapter are identified and described in chapter 2.*

4.2 Operating Instructions

WARNING: The procedures given below must be performed only by a trained operator.

The following procedures are provided in this section:

- Starting the UPS system from the maintenance bypass *(see paragraph 4.2.1)*.
- Individual module start/stop procedure in a parallel system *(see paragraph 4.2.2)*.
- Transfer the load from UPS to maintenance bypass mode *(see paragraph 4.2.3)*.
- Complete system shutdown *(see paragraph 4.2.4)*.

4.2.1 Starting the UPS system from the maintenance bypass

This procedure describes the sequence of operations necessary to power up the UPS module(s) whilst the load is connected to the maintenance bypass supply, and then transfer the load to the UPS inverter(s) ('On-Line' mode).

WARNING: All the operations in this section must be performed by authorised and trained personnel.

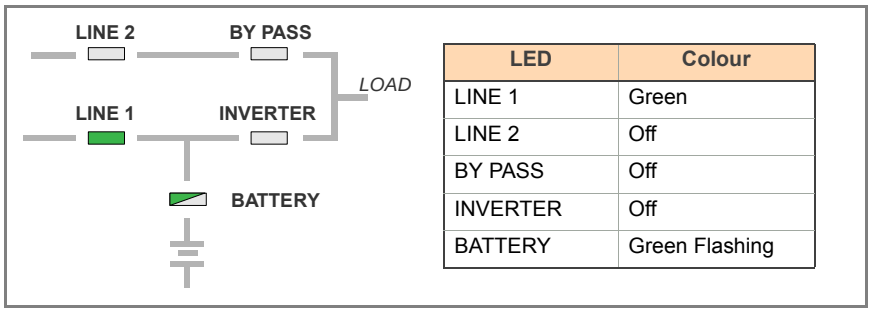
Prior to powering-up the system, check and confirm the UPS system status:

- The load is supplied via the maintenance bypass switch (closed in all modules)
- The UPS module(s) are powered down

Powering up the UPS module(s):

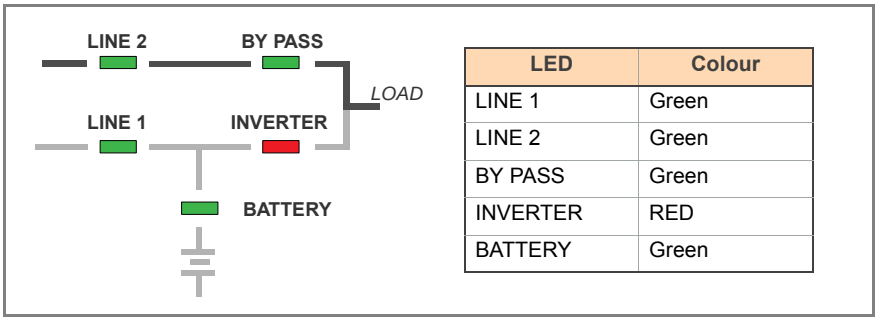
In a multi-module system perform each of the steps in turn on every module.

1. On the UPS power module close the bypass line fuse holder F2 if open.
2. Close the battery fuses/breaker (in external battery cabinet if fitted).
   a) The UPS mimic panel `LINE 1` LED will be permanent green.
   b) The `BATTERY` LED will be flashing green.
   c) The LCD display will indicate `LOAD OFF, SUPPLY FAILURE.`



LED	Colour
LINE 1	Green
LINE 2	Off
BY PASS	Off
INVERTER	Off
BATTERY	Green Flashing

3. Close the parallel isolator switch (IA2) and check that the `PARALLEL SW CLOSED` message is shown on the LCD display.
4. On the UPS mimic panel press and release both `ON/OFF` buttons simultaneously and wait approximately 60 seconds.
   a) The UPS module will begin to power up.
   b) Initially `LINE 2` LED will be red, then change to green.
   c) At this stage the LCD display will indicate `LOAD NOT PROTECTED` and the module mimic LED indications should be as follows:

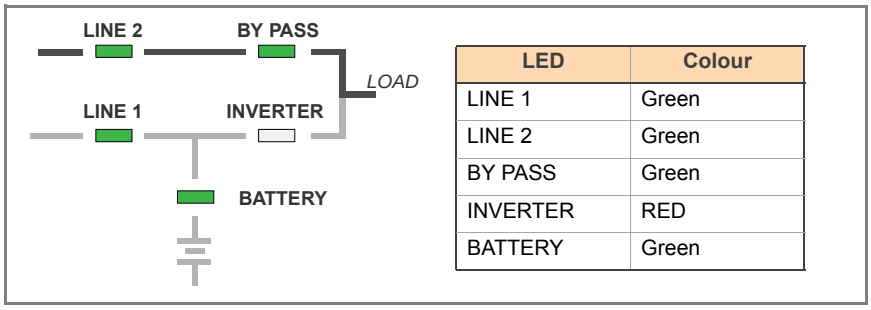


LED	Colour
LINE 1	Green
LINE 2	Green
BY PASS	Green
INVERTER	RED
BATTERY	Green

5. When powering up a multi-module system ensure that ALL the modules are in the state shown above before continuing with this procedure.

Transferring the load to the UPS from the maintenance bypass:

6. Ensure that the BYPASS LED is green (on all modules).
7. Open the maintenance bypass switch (IA1) (on all cabinets in a multi-cabinet system).
   a) The LCD panels will display MANUAL BYPASS OPEN.
   b) The INVERTER LED will be extinguished.
   c) An audible alarm will sound.

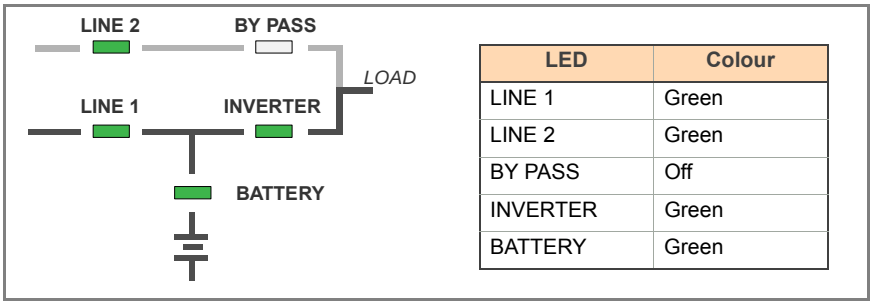


LED	Colour
LINE 1	Green
LINE 2	Green
BY PASS	Green
INVERTER	RED
BATTERY	Green

8. Press the RESET button to cancel the audible alarm (on all modules).
   a) The LCD display(s) will now indicate LOAD NOT PROTECTED.

Transferring the load to the inverter:

9. On the control panel (of any one module in a parallel module system):
   a) Press the UP key once to access the menu system.
   b) Use the UP/DOWN keys to move the cursor so that it is adjacent to COMMANDS then press the ENTER key.
   c) Use the UP/DOWN keys move the cursor so that it is adjacent to LOAD TO INVERTER then press the ENTER key.
10. The UPS system will now transfer the load to inverter (on all modules in a parallel-module system).
    a) The LCD display(s) will now indicate LOAD PROTECTED.
    b) Check and confirm that the LED display(s) are as shown below:



LED	Colour
LINE 1	Green
LINE 2	Green
BY PASS	Off
INVERTER	Green
BATTERY	Green

11. The UPS is now operating in ‘On-Line’ mode. The load is protected and supplied by inverter power.

4.2.2 Individual module start/stop procedure in a parallel system

If a multi-module system is designed with redundancy it is possible to stop and start one module without affecting the operational status of the remainder of the system – e.g. one module can be taken off-line for servicing whilst the remaining modules maintain a protected load supply.

WARNING: All the operations in this section must be performed by authorised and trained personnel.

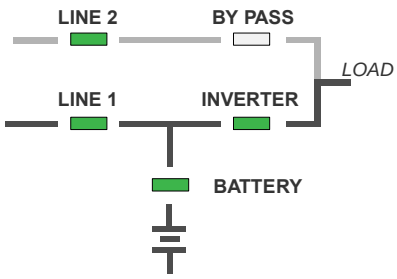
Module start-up:

Use this procedure to start a module and connect it to a multi-module system.

This procedure assumes the following initial conditions:

- The fused battery isolator(s) are open (in the UPS cabinet or external battery cabinet)
- In the UPS cabinet, the module's bypass isolator (F2) and the parallel isolator (IA2) are open

1. In the UPS cabinet, close the module's bypass isolator (F2) and the parallel isolator (IA2).
2. Close the UPS input supply isolator at the LV switchboard (if open).
   a) The LINE 1 indicator will illuminate green.
   b) The LCD display will indicate LOAD OFF SUPPLY FAILURE. If necessary press the RESET button to obtain this display.
3. Close the fused battery isolator(s) associated with the module.
4. Simultaneously press the two ON/OFF push buttons on the UPS control panel.
   a) The UPS will run through an automated start-up sequence accompanied by the following indications:
   LINE 2 LED lights red then changes to green.
   INVERTER LED lights green.
   BATTERY LED lights green (constant).
   b) LCD displays the LOAD PROTECTED message.



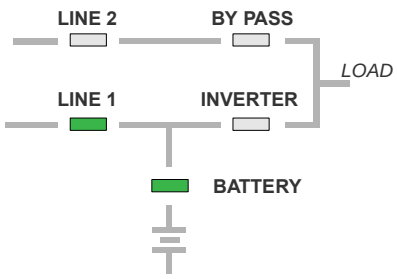
LED	Colour
LINE 1	Green
LINE 2	Green
BY PASS	Off
INVERTER	Off
BATTERY	Green

5. The UPS module is now On Line and connected to the parallel system.

Module shut-down:

Use this procedure to power down a single UPS power module in a redundant module system.

1. Simultaneously press the two ON/OFF buttons on the UPS module's control panel.
   a) The LED display will give the following indications:



LED	Colour
LINE 1	Green
LINE 2	Off
BY PASS	Off
INVERTER	Off
BATTERY	Green

2. Open the parallel isolator switch IA2.
3. In the UPS cabinet, open the module's bypass supply fused isolators F2.
4. Open the fused battery isolator(s) associated with the module.
5. The UPS module is now shut-down.

4.2.3 Transfer the load from UPS to maintenance bypass mode

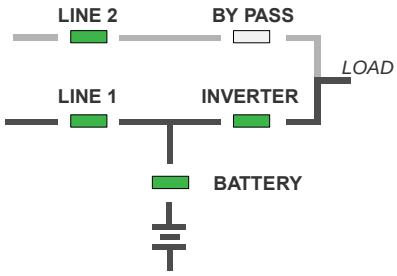
If needed, to perform service or maintenance, it is possible to transfer the load to maintenance bypass and power down the UPS module(s) whilst leaving the load connected to the raw bypass mains supply.

WARNING: Before you close the maintenance bypass isolator ensure that the UPS is operating in the (static) bypass mode.
All the operations in this section must be performed by authorised and trained personnel.

This procedure describes the sequence of operations to transfer the load to the maintenance bypass supply and then shut down, and isolate, the UPS module(s).

Prior to commencing this procedure, check and confirm the following UPS system status (on all modules in a parallel system):

- The mimic panel LED indications should be as per the following table (on all modules in a multi-module system):

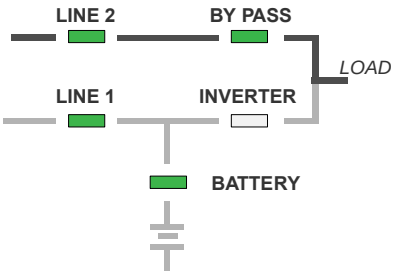


LED	Colour
LINE 1	Green
LINE 2	Green
BY PASS	OFF
INVERTER	Green
BATTERY	Green

- The LCD panel should display `LOAD PROTECTED`. If anything other than `LOAD PROTECTED` is displayed then press the `RESET` button, and if `LOAD PROTECTED` is still not displayed there is a problem with the UPS – seek assistance!

Transferring the UPS to (static) bypass mode:

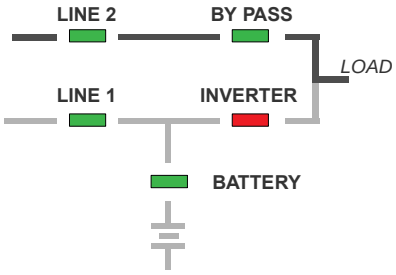
1. On any one of the UPS module's mimic panel press the `ENTER` key once to access the menu system.
2. Using the `UP/DOWN` keys, move the cursor so that it is adjacent to `COMMANDS` and then press the `ENTER` key.
3. Using the `UP/DOWN` keys, move the cursor so that it is adjacent to `LOAD TO BYPASS` and then press the `ENTER` key.
   a) The UPS system will transfer the load to static bypass on all connected modules.
4. *On all modules* check and confirm that:
   a) The `INVERTER` LED has extinguished.
   b) The `BYPASS` LED is green.
   c) The LCD displays `LOAD NOT PROTECTED`.



LED	Colour
LINE 1	Green
LINE 2	Green
BY PASS	Green
INVERTER	OFF
BATTERY	Green

Closing the maintenance bypass switch:

5. Close the maintenance bypass switch IA1 (in all cabinets in a multi-cabinet system).
6. On all UPS modules check and confirm that:
   a) The INVERTER LED has turned to red.
   b) The BYPASS LED is green.
   c) The LCD displays MANUAL BYP IS CLOSED.



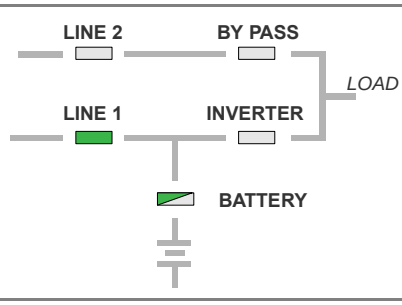
LED	Colour
LINE 1	Green
LINE 2	Green
BY PASS	Green
INVERTER	RED
BATTERY	Green

Powering down a UPS module:

When the load is connected to the maintenance bypass supply, as described above, the UPS module(s) can be powered down (for example, if required for maintenance/testing) using the following procedure:

Note: Carry out the following procedure on each module in a parallel system to totally shut down the system.

7. On the UPS control panel simultaneously press both ON/OFF buttons.
   a) The LCD panel will indicate: LOAD OFF, SUPPLY FAILURE.
8. Open the fused battery isolator(s) associated with the module.
9. Open the module's parallel isolator (IA2).



LED	Colour
LINE 1	Green
LINE 2	Off
BY PASS	Off
INVERTER	Off
BATTERY	Green Flashing

10. Open the bypass line fuse holder F2.

WARNING: The UPS cabinet is still live at its input and output power terminals due to the closure of maintenance bypass isolator.
WARNING: Allow 10 minutes for the internal DC capacitors to discharge before touching any UPS internal components.
WARNING: The load is now supplied from the bypass mains and is not protected against power failure.

4.2.4 Complete system shutdown

The UPS system may be shutdown completely if the load does not require power for an extended period of time. Use this procedure to turn off the load power and shutdown the entire UPS system.

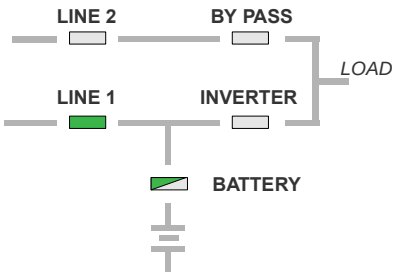
WARNING: All the operations in this section must be performed by authorised and trained personnel.

CAUTION: *This procedure will totally disconnect load power. Ensure that it is safe to lose power to all the loads connected to the UPS system before you begin this process.*

1. Isolate all load equipment connected to the output of the UPS system by opening the fused isolators or circuit breakers in the load distribution board.

WARNING: Perform the following steps only after the load has been fully isolated.

2. Verify that the loads are powered down. Then carry out the following actions on every module in a multi-module system.
3. On the UPS control panel simultaneously press both `ON/OFF` buttons.
   a) The LCD panel will indicate: `LOAD OFF, SUPPLY FAILURE.`
4. Open the fused battery isolator(s) associated with the module.
5. Open the module's parallel isolator switch (IA2).



LED	Colour
LINE 1	Green
LINE 2	Off
BY PASS	Off
INVERTER	Off
BATTERY	Green Flashing

6. Open the module's bypass line fuse holder F2.
7. Isolate the UPS input/bypass supplies at the input distribution board.
8. The UPS is now voltage free.

WARNING: Allow 2 minutes for the internal DC capacitors to discharge before touching the UPS internal components.

4.3 Replacement of the UPS module in a single module system

WARNING: All the operations in this section must be performed by authorised and trained personnel. By opening or removing the UPS modules and module covers you run risk of exposure to dangerous voltages!

WARNING: When removing a UPS module wait for at least 10 minutes after it has been disconnected in order to allow the DC Capacitors to fully discharge.

WARNING: When the UPS module is removed from the cabinet always fit an appropriate blanking cover.

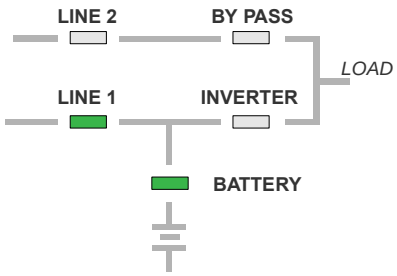
WARNING: Two persons are needed to pull out the module from the UPS Frame. The weight of a DPA 50, 40kW module is 60kg. Employ suitable lifting aids and safety platforms where possible.

If a UPS-module goes faulty in a single module system (e.g. DPA-50), the load will automatically transfer to the UPS bypass supply (BYPASS mode) and the load is unprotected against a mains supply failure.

4.3.1 Removing a UPS Module in a single module system (e.g. DPA-50)

If your PowerWave 9000 consists of a single UPS power module then perform the following steps to shutdown and extract the module:

1. Transfer the load to the maintenance bypass *(see paragraph 4.2.1)*.
   a) The load is now directly supplied by mains and is not protected
2. Simultaneously press the two `ON/OFF` buttons on the UPS control panel.
   a) The LED display will give the following indications:



LED	Colour
LINE 1	Green
LINE 2	Off
BY PASS	Off
INVERTER	Off
BATTERY	Green

3. Open the fused battery isolator(s) associated with the module.
   a) The UPS module is now totally shut-down.
4. Disconnect cables from connectors JD7 and remove the four screws on the front of the UPS module that secure it to the cabinet frame.
5. Pull the UPS power module forwards until the rear connectors are disconnected. DO NOT FULLY EXTRACT THE UNIT.

WARNING: Wait at least 2 minutes to allow the module's electrolytic capacitors time to discharge.

6. Wait two minutes then fully withdraw the UPS power module from the cabinet by pulling it forwards horizontally.
7. If you are not intending to replace the UPS module immediately, cover the UPS compartment opening with an appropriate protection cover and secure with the four screws removed earlier.

4.3.2 Refitting the UPS module

1. Remove the UPS module compartment protection cover (if fitted) by unscrewing four screws on the front.
2. Using two persons to lift the UPS module, slide two thirds of the module into the UPS-compartment (make sure not to plug the UPS-Module into the rear connector).
3. When you are certain the module is located correctly on its guide rails, push it firmly into its final position, to assure good contact on the rear plugs.
4. Tighten the four screws on the front of module to secure the module to the cabinet frame.
5. Connect the control panel cable to connector JD7.
6. Start the UPS module and bring it on line *(see paragraph 4.2.1)*.

4.4 Replacing a module in a REDUNDANT multi-module system

WARNING: All the operations in this section must be performed by authorised and trained personnel. By opening or removing the UPS modules and module covers you run risk of exposure to dangerous voltages!

WARNING: When removing a UPS module wait for at least 2 minutes after it has been disconnected in order to allow the DC capacitors to fully discharge.

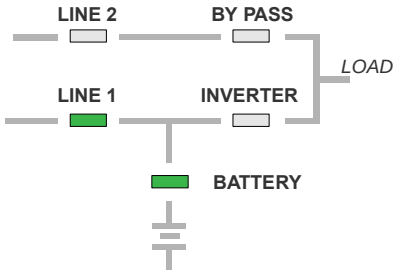
WARNING: When the UPS module is removed from the cabinet always fit an appropriate blanking cover.

WARNING: Two persons are needed to pull out the module from the UPS Frame. The weight of a DPA 50, 40kW module is 60kg (the weight of DPA 10, 8kW60 module is 24kg).
Employ suitable lifting aids and safety platforms where possible.

If a UPS module goes faulty in a REDUNDANT parallel system, the load will continue to be protected by the remaining modules which will remain operating in the ON-LINE mode (INVERTER mode). Under these circumstances the faulty UPS module can be replaced without having to transfer the load to bypass.

4.4.1 Removing the UPS module

1. On the UPS module to be replaced, simultaneously press the two ON/OFF buttons on the UPS control panel.
   a) The LED display will give the following indications:



LED	Colour
LINE 1	Green
LINE 2	Off
BY PASS	Off
INVERTER	Off
BATTERY	Green

2. Open the UPS module's parallel isolator (IA2).
3. Open the fused battery isolator(s) associated with the module.
4. The UPS module is now totally shut-down.
5. Disconnect the control panel cable to connector JD7.
6. Remove the four screws on the front of the UPS module that are fixing it to the cabinet.

7. Pull the UPS module forwards until the rear connectors are disconnected. DO NOT FULLY EXTRACT THE UNIT.

WARNING: Wait at least 2 minutes to allow the module's electrolytic capacitors time to discharge.

8. After waiting two minutes, fully withdraw the UPS-Module from the cabinet by pulling it horizontally.
9. If you are not intending to replace the UPS module immediately, cover the UPS compartment opening with an appropriate protection cover and secure with four screws.

4.4.2 Inserting a UPS module

Key Point: The replacement module must be preset according to system personalization. Please make sure with your nearest service centre for correct settings.

1. Remove the UPS module compartment protection cover (if fitted) by unscrewing four screws on the front.
2. Using two persons to lift the UPS module, slide two thirds of the module into the UPS-compartment (make sure not to plug the UPS-Module into the rear connector).
3. Push UPS-module firmly into its final position, to assure good contact on the rear plugs.
4. Tighten the four screws on the front of module to secure it to the UPS cabinet / frame.
5. Connect the control panel cable to connector JD7.
6. Start the UPS module and bring it on line *(see paragraph 4.2.2)*.

4.5 Replacing a module in a CAPACITY multi-module system

WARNING: All the operations in this section must be performed by authorised and trained personnel. By opening or removing the UPS modules and module covers you run risk of exposure to dangerous voltages!

WARNING: When removing a UPS module wait for at least 2 minutes after it has been disconnected in order to allow the DC Capacitors to fully discharge.

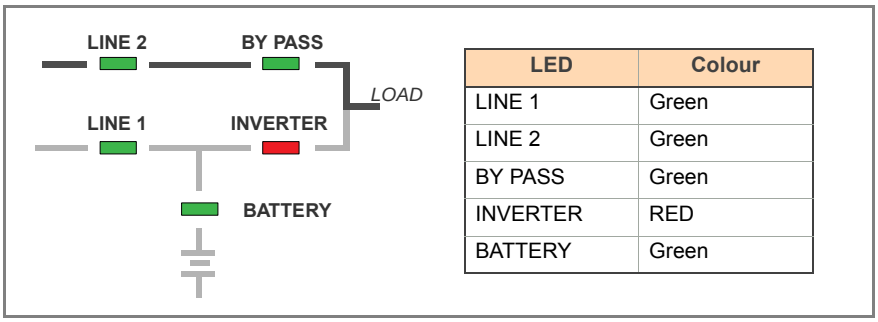
WARNING: When the UPS module is removed from the cabinet always fit an appropriate blanking cover.

WARNING: Two persons are needed to pull out the module from the UPS Frame. The weight of a DPA 50, 40kW module is 60kg. Employ suitable lifting aids and safety platforms where possible.

If a UPS module fails and there is not enough capacity left to protect the load by the remaining operating UPS modules, the load will automatically transfer to the (static) bypass and continue to be supplied from the mains supply.

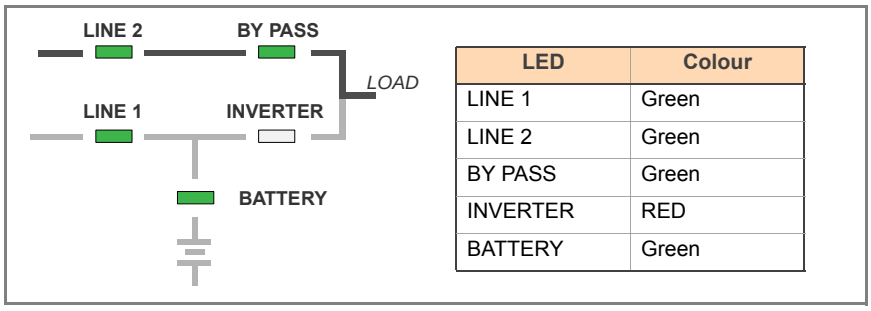
4.5.1 Removing a module

1. Verify that the load is on BYPASS and is supplied by the mains power on ALL UPS modules.
   a) In the majority of the events the LED indicators on control panel of a faulty module will show:



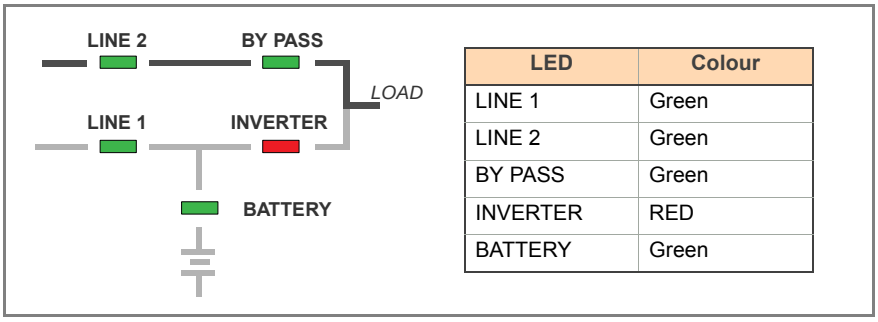
LED	Colour
LINE 1	Green
LINE 2	Green
BY PASS	Green
INVERTER	RED
BATTERY	Green

   b) Whereas the LED indicators on the control panels of the remaining healthy modules will show:



LED	Colour
LINE 1	Green
LINE 2	Green
BY PASS	Green
INVERTER	RED
BATTERY	Green

2. Close maintenance bypass switch IA1 (in all cabinets in a multi-cabinet system)
3. On **all** modules check and confirm that:
   a) The INVERTER LED has turned to red.
   b) The BYPASS LED is green.
   c) The LCD displays MANUAL BYP IS CLOSED.



LED	Colour
LINE 1	Green
LINE 2	Green
BY PASS	Green
INVERTER	RED
BATTERY	Green

4. Open the parallel isolator switch (IA2) of the UPS module to be replaced.
5. Open the fused battery isolator(s) associated with the module.
6. The UPS module is now totally shut-down.
7. Disconnect the control panel cable to connector JD7.
8. Remove the four screws on the front of the UPS module that are fixing it to the cabinet frame.
9. Pull the UPS module forwards until the rear connectors are disconnected. DO NOT FULLY EXTRACT THE UNIT.

WARNING: Wait at least 2 minutes to allow the module's electrolytic capacitors time to discharge.

10. After waiting two minutes, fully withdraw the UPS power module from the cabinet by pulling it forward horizontally.
11. If you are not intending to replace the UPS module immediately, cover the UPS compartment opening with an appropriate protection cover and secure with four screws.

CAUTION: *While the UPS is operating in the maintenance bypass mode the load is not protected and in the event of a mains failure the load supply will be interrupted.*

4.5.2 Refitting a module in a capacity multi-module system

1. Remove the UPS module compartment protection cover (if fitted) by unscrewing four screws on the front.
2. Using two persons to lift the UPS module, slide two thirds of the module into the UPS-compartment (make sure not to plug the UPS-Module into the rear connector).
3. Push UPS-module firmly into its final position, to assure good contact on the rear plugs.
4. Tighten the four screws on the front of module to secure it to the UPS cabinet / frame.
5. Connect the control panel cable to connector JD7.
6. Start the UPS module and transfer the load from the maintenance bypass back to the UPS system *(see paragraph 4.2.1)*.

5 Maintenance

5.1 Introduction

WARNING: All the operations described in this chapter must be performed by an authorised electrician or manufacturer-trained personnel.

5.2 System calibration

To ensure optimum UPS operation and continuous, efficient protection of the connected load, it is recommended that the system's operating parameters are checked every six months and recalibrated where necessary. The batteries should also be checked every six months, depending on the ambient temperature.

5.3 User responsibilities

There are no user-serviceable parts contained within the UPS so the maintenance requirements of the user are minimal. To maximise the useful working life and reliability of the UPS and its batteries, the environment in which the UPS operates should be kept cool and dust free.

5.4 Routine maintenance

It is essential that the UPS system and batteries receive regular preventative maintenance inspection to maximise both the useful working life and the reliability of the UPS system. When the UPS is commissioned, the commissioning field service engineer will attach a service record book to the front of the UPS which will be used to log the full service history of the UPS.

Preventative maintenance inspections involve working inside the UPS which contains hazardous AC and DC voltages.

WARNING: Only Uninterruptible Power Supplies Ltd. trained and authorised field service engineers are fully aware of all of the hazardous areas within the UPS.

During a preventative maintenance inspection the field service engineer will check:

- Site/environment conditions
- Integrity of electrical installation
- Cooling airflow
- Rectifier operation and calibration
- Inverter operation and calibration
- Static switch operation
- Battery status
- Load characteristics
- Integrity of alarm and monitoring systems
- Operation of all installed options

Preventative maintenance inspections form an integral part of all Extended Warranty Agreements (maintenance contracts) offered by Uninterruptible Power Supplies Ltd.

For further details on Extended Warranty Agreements see paragraph 2.7.

5.5 Battery testing

The battery test takes approximately 3 minutes and should be performed only if:

- There are no alarm conditions
- The battery is fully charged
- The input mains supply is present

Battery testing can be carried out independently of the operating mode (Off-line or On-line) and whether or not the load is connected.

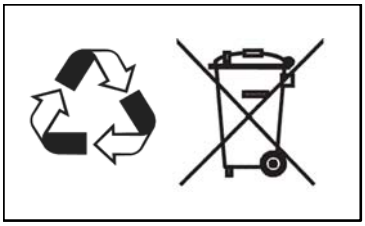
The battery test procedure can be performed from the UPS front panel (See paragraph 4.3.5).

5.6 Battery maintenance

The battery maintenance shall be done by an authorized Uninterruptible Power Supplies Ltd Service Partner.

5.7 Battery disposal and recycling

Batteries contain dangerous substances that will harm the environment if thrown away. If you change the batteries yourself, call qualified organizations for battery disposal and recycling.



6 Troubleshooting

6.1 Alarms

In the event of an alarm condition the red ALARM LED-indicator will illuminate on the operator control panel and the audible alarm will sound.

In this case proceed as follows:

1. Silence the audible alarm by pressing the RESET button.
2. Identify the cause of the alarm condition by means of the events register in the main menu *(see paragraph 2.5.3)*.
3. In case of doubt please contact your nearest service agent or call Uninterruptible Power Supplies Ltd. on 0800 731 3269.

Fault identification and rectification information is given on the following pages.

6.2 Menu, Commands, Event Log, Measurements,

A detailed description of the Menu, Commands, Event Log and Measurements that can be operated and displayed on the LCD can be found on page 15.

Event Log Screen

DESCRIPTION	LCD-DISPLAY
1. Logging Control	05-10-00 14-38-56 LOAD TO INV.
2. A log of the last 64 events is stored in the Power Management Display.	05-10-00 14-38-59 LOAD TO BYP.
3. All events and alarms are indicated with their date and time of occurrence.	05-10-00 14-39-14 LOAD OFF

The full list of Alarms and Messages are shown in paragraph 6.3.

As you step through the event memory, make a separate note of each alarm condition as this will assist in the identification of any problems.

6.3 Fault Identification and Rectification Messages and Alarms

Messages will not appear automatically on the LCD as they occur, but will be recorded in the Event Log, with the time and date of their occurrence.

Alarm Condition	Interpretation	Suggested Solution
UPS FAULT	There is a fault in the UPS and therefore normal operation cannot be guaranteed.	Call an authorised service centre for assistance.
MAINS BYP/RECT FAULT	Mains power supply is outside prescribed tolerance.	The UPS input supply is too low or missing. If site power appears to be OK, check the external input supply circuit breakers etc.
OUTPUT SHORT	There is a short circuit at the output of UPS (on load side).	Check all output connections and repair as required.
OVERLOAD	Load exceeds the UPS rated power.	Identify which piece of equipment is causing the overload and remove it from the UPS. Do not connect laser printers, photocopiers, electric heaters, kettles etc. to the UPS
OVERTEMPERATURE	The UPS temperature has exceeded the maximum permitted value.	Check that the UPS ambient temperature is less than 30° C. If the ambient temperature is normal call the authorised service centre for assistance.
BATTERY CHARGER OFF	Either the attached battery and the battery charger set-up do not correspond or there is a battery charger fault.	Call an authorised service centre for assistance.
INVERTER FAULT	Inverter is faulty.	Call an authorised service centre for assistance.
SYNCHRON FAULT	The inverter and mains are not synchronised.	The frequency of the UPS input supply is outside preset operational limits and the UPS static bypass has been temporarily disabled.
BATTERY IN DISCHARGE	Battery is near end of autonomy.	Shutdown the load connected to UPS before the UPS switches itself off to protect its batteries.
MANUAL BYP IS CLOSED	Maintenance Bypass closed. Load supplied by mains.	This alarm is only displayed if the UPS is on Maintenance Bypass.

6.4 Contacting Service

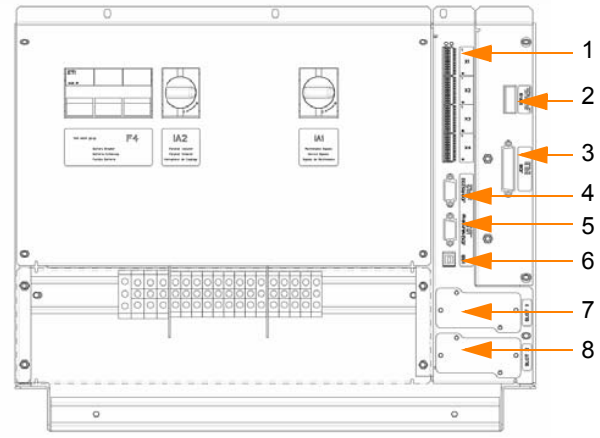
Uninterruptible Power Supplies Limited has a service department dedicated to providing routine maintenance and emergency service cover for your UPS. If you have any queries regarding your UPS please contact us.

Uninterruptible Power Supplies Ltd. Woodgate Bartley Wood Business Park Hook Hampshire RG27 9XA	
Tel:	01256 386700 0800 731 3269 (24 Hr.)
Fax:	01256 386701
Email:	service@upspower.co.uk

We recommend that your UPS is protected by an Extended Warranty Agreement (see Section 2 for details). These agreements assist us in caring for your UPS correctly, ensuring that it is well maintained and attended to promptly should any problems occur.

7 Options

7.1 Introduction



1. X1-X4 Customer interface on Phoenix Terminals:
   X1 Customer Inputs
   X2…X4 = Potential free contacts
2. SW1-9 Multi-Cabinet Configuration Switch
3. JD8 Parallel BUS connector
   Only for paralleling cabinets use optional adapter:
   JD5 Parallel BUS - Input Connector
   JD6 Parallel BUS - Output Connector
4. JD11 RS232 / Sub D9/ female, PC interface
5. JD12 RS232/ Sub D9 / male for Multidrop ONLY
6. USB PC Interface
7. SNMP Slot for optional SNMP card ONLY
8. Slot for optional Modem/Ethernet card ONLY

Figure 7.1 UPS Interface board (DPA-50 details shown)

Each UPS cabinet is fitted with an interface board, as shown in Figure 7.1, which enables various external monitoring and control applications to be connected to the UPS system to satisfy particular site requirements. The interface board's input and output connections are shown above in Figure 7.1

The interface board has two LEDs:

- The green LED indicates the status of the interface and blinks twice per second when the board is fitted to the 'master' UPS (1st cabinet in the parallel system), and once per second when the board is fitted to a 'slave' UPS.
- The red LED is an alarm indication and illuminates to indicate a possible faulty board.

The following ports are active on the interface board when fitted to the 'master' UPS cabinet:

- The Input ports (X1)
- The Output port (X2, X3, X4)

The following ports are active on the Interface Board when fitted to a Slave cabinet:

- The Output ports X3/6 … X3/10
- The Output ports X4/1 …X4/10 (Means Alarm. Module 1, 2, 3,4, 5)
- All other input or output ports on the Slave boards are not activated

These interfaces are described below.

- Dry port customer interface – X1 (customer inputs), X2-X4 (customer outputs) *(see paragraph 7.2)*
- RS232 Computer serial interface – USB & JD11 *(see paragraph 7.3)*
- RS232 Interface for multidrop – JD12 *(see paragraph 7.4)*
- SNMP/ Modem slots for remote monitoring/control – *(see paragraph 7.5)*
- Cabinet paralleling connection and configuration – *(see paragraph 3.9)*

7.2 Dry port (volt-free contacts)

Customer I/O interface facilities are made to Phoenix spring terminal blocks (cable 0.2mm² to 1.5mm²) annotated X1, X2 and X3. All voltage-free contacts are rated at 250Vac/8A, 30Vdc/8A, 110Vdc/0.3A, 220Vdc/0.12A

7.2.1 Input interfaces terminal block X1

The customer inputs normally connected to the input interface terminal block X1 are:

- Remote (emergency) shutdown
- Generator ON
- Customers specials functions

Term	Contact	Signal	Display	Function
X1/1 X1/2		+3.3Vdc GND		Remote Shutdown - (Do not remove the factory mounted bridge until external Remote Shut down is connected)
X1/3 X1/4		+3.3Vdc GND		Generator Operation
X1/5 X1/6		+3.3Vdc GND		Customer IN 1
X1/7 X1/8		+3.3Vdc GND		Customer IN 2
X1/9 X1/10		+3.3Vdc GND		Temperature Battery

Figure 7.2 Dry Port (X1) Connections

Remote emergency shutdown customer input

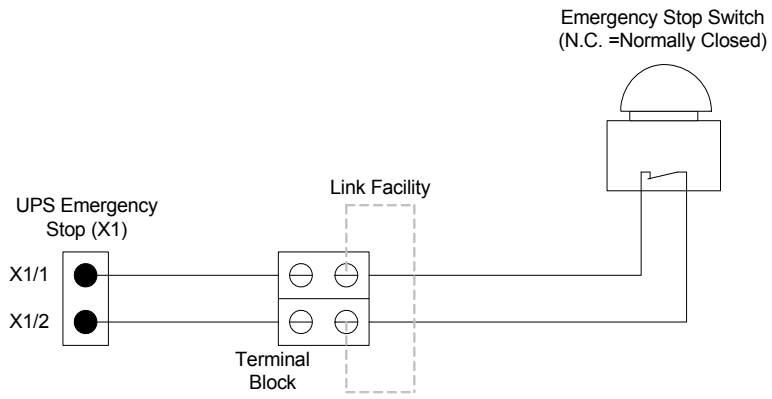


Figure 7.3 Remote Emergency OFF Switch Cabling

The remote emergency stop input uses a normally-closed contact which opens to trigger the emergency stop sequence.

In order to allow maintenance or testing of the remote emergency stop circuit without disturbing the normal UPS operation it is recommended that a terminal block with linking facilities is installed between the UPS and the remote emergency stop button, as shown.

1. Use a screened cable with 1 pair (section of wires 0.6 mm^2) and maximum length of 100 m.
2. Connect the cable as shown in Figure 7.3.

Generator ON customer input

The Generator ON input uses a normally-open contact which closes to indicate that the standby generator is running and supplying input power to the UPS.

When used, this facility enables an option to inhibit the operation of the battery charger and/or static bypass (see *Set-up User menu screen* on *page 18).*

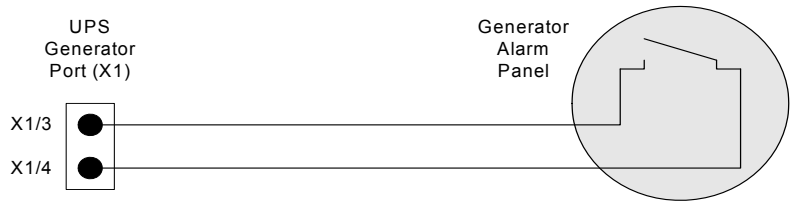


Figure 7.4 Generator ON Connection

1. Use a screened cable with 1 pair (section of wires 0.6 mm^2) and maximum length of 100 m.
2. Connect the cable as shown in Figure 7.3.

7.2.2 Output interfaces terminal blocks X2, X3, X4

These volt-free changeover outputs provide signals that can be used for the automatic and orderly shutdown of servers, AS400; or used as control inputs to building management systems.

Term	Contact	Signal	Display	Function
X2/1		ALARM	MAINS_OK	Mains Present
X2/2				Mains Failure
X2/3				Common
X2/4		Message	LOAD_ON_INV	Load on Inverter
X2/5				Load on Bypass
X2/6				Common
X2/7		ALARM	BATT_LOW	Battery Low
X2/8				Battery OK
X2/9				Common
X2/10		Message	LOAD_ON_MAINS	Load on Bypass
X3/1				Load on Inverter
X3/2				Common
X3/3		ALARM	COMMON_ALARM	Common Alarm
X3/4				No Alarm
X3/5				Common
X3/6		ALARM	MODUL_ALARM1	Module 1 Alarm
X3/7				No Alarm
X3/8				Common
X3/9		ALARM	MODUL_ALARM2	Module 2 Alarm
X3/10				No Alarm
X4/1				Common
X4/2		ALARM	MODUL_ALARM3	Module 3 Alarm
X4/3				No Alarm
X4/4				Common

Term	Contact	Signal	Display	Function
X4/5		ALARM	MODUL_ALARM4	Module 4 Alarm
X4/6				No Alarm
X4/7				Common
X4/8		ALARM	MODUL_ALARM5	Module 5 Alarm
X4/9				No Alarm
X4/10				Common

Figure 7.5 Dry port (X2– X4) connections

7.3 RS232 Computer serial interface – USB & JD11

A serial RS 232 interface is available through a standard 9-pin D-Type female socket (JD1) or USB port to provide an intelligent RS 232 serial port which allows the UPS to be connected to a computer.

When used in conjunction with the optional WAVEMON software, this port allows the connected computer to continuously monitor the input mains voltage and UPS status, and display a message in the event of any UPS system changes.

Figure 7.6 shows the cable wiring suitable for PC's with a 9 pin or 25 pin serial port respectively. Note that the maximum length for the interconnecting RS232 cable is 15m.

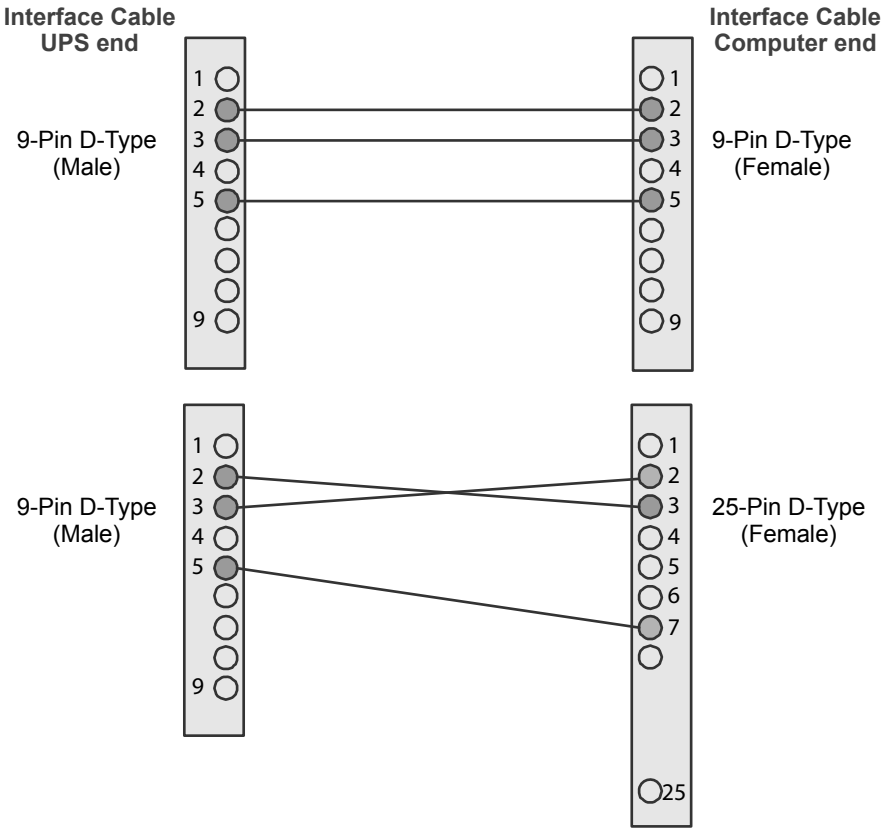


Figure 7.6 PC Serial port connector cable

7.4 RS232 Interface for multidrop – JD12

The Computer Interface JD12 (5) l is an intelligent RS232 serial port that monitors signals from several UPS cabinets connected in parallel. The connector JD12 is a standard D-Type, 9-pin, male.

7.5 SNMP/ Modem slots for remote monitoring/control

Simple Network Management Protocol (SNMP) is a world-wide, standardised communication protocol that can be used to monitor any network-connected device via a simple control language and display the results in an application running within a standard web browser.

The PowerWave 9000 contains two SNMP slots; one is designed to house a Modem/Ethernet SNMP adapter card and the other a Modem/GSM adapter (see Figure 7.1). Alternatively, SNMP connectivity can also be implemented using an external SNMP adapter connected to the UPS RS232 output (JD11).

An SNMP/Ethernet adapter contains an RJ-45 connector which allows it to be connected to the network using a standard network cable. Once connected, the UPS-Management software agent, which is already installed in the SNMP adapter, then monitors the UPS operating parameters and outputs its data in SNMP format to the connected network. In a multi-module UPS system the SNMP interface can communicate 'system-wide' data or data for an individual UPS module.

The SNMP adaptor requires a PC with terminal connections, and for normal operation at least one network connection (Ethernet) is also required.

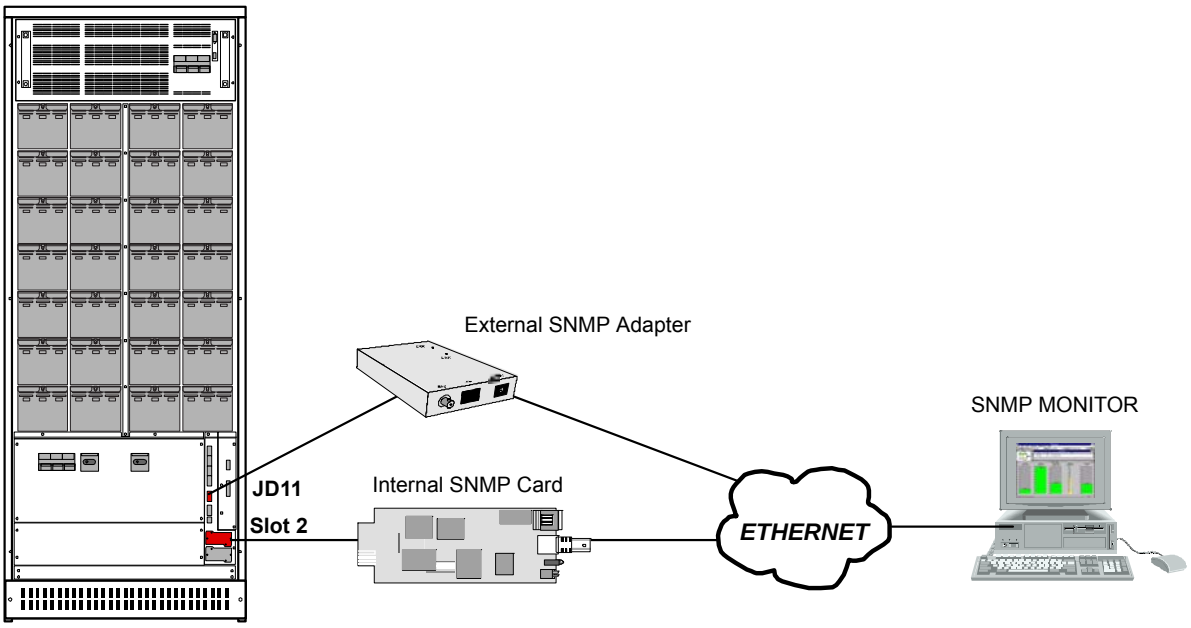


Figure 7.7 SNMP Internal and external SNMP adapters

7.6 UPS Monitoring and automated control software

7.6.1 The importance of UPS management

The utility supply is inevitably unreliable every now and then; and assuring continuous power to all the facilities connected to it can be a difficult task. The situation is further complicated if worldwide systems are managed via a Local Area Network (LAN) or Wide Area Network (WAN).

However, by using the PowerWave 9000 UPS system in conjunction with purpose-designed network management tools, a systems administrator can take measures to back-up data and prevent system errors or data loss even in the event of a relatively long utility supply outage. In the case of an abnormal utility supply, suitable UPS management software will also enable a system administrator to monitor all concerned networks from a central point and identify bottlenecks at an early stage.

In spite of extensive system monitoring, if an administrator fails to intervene in a timely manner serious damage can still occur. It is important therefore that the installed UPS software will react automatically in such a case and shut down the supplied system in a safe and controlled manner.

Uninterruptible Power Supplies Ltd considers it important to have a complete solution for its UPS systems, and offers its customers a number of remote control and monitoring tools to provide optimum protection.

Two monitoring system options are available for use with the PowerWave 9000 UPS system:

SNMP monitoring software

The SNMP adapter described above requires a PC with terminal connections and, for normal operation, at least one Ethernet network connection. It also requires that the network operating system in use is SNMP-compatible.

Uninterruptible Power Supplies Ltd offer suitable monitoring software with SNMP functionality for NetWare, OS/2, all Windows NT systems on INTEL and ALPHA network platforms.

WAVEMON UPS monitoring and control software

WAVEMON is designed to operate in conjunction with many of the systems supplied by Uninterruptible Power Supplies Ltd and features both UPS monitoring and automatic UPS/server shutdown facilities. The system comprises a bespoke software package which is installed on a local PC and communicates with the UPS over a standard RS232 cable of up to 15m in length.

7.6.2 WAVEMON Shutdown and Management Software

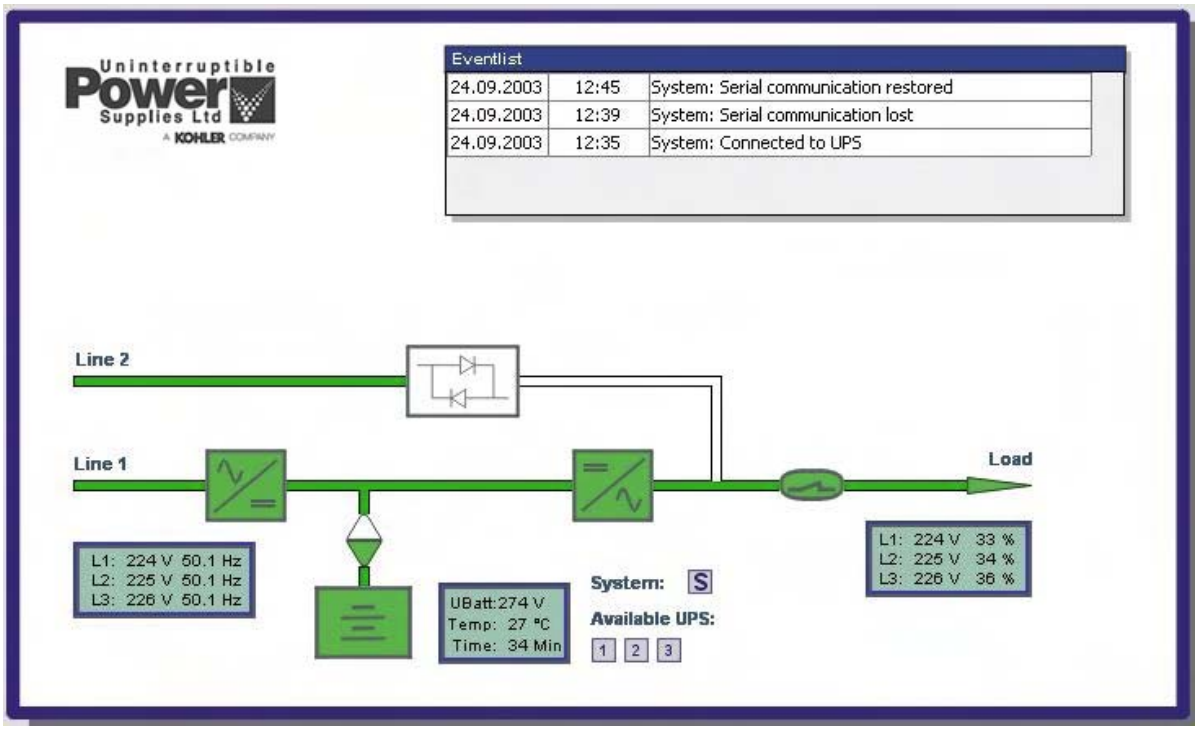


Figure 7.8 Monitoring screen image.

WAVEMON is a software application designed to operate with many of the systems supplied by Uninterruptible Power Supplies Ltd and features both UPS monitoring and automatic UPS/server shutdown facilities. It comprises a bespoke software package which is installed on a local PC and communicates with the UPS via USB or a standard RS232 serial cable of up to 15m in length. It is only required when an SNMP card or adapter box is not purchased.

Uninterruptible Power Supplies Ltd offer suitable monitoring software with SNMP functionality for NetWare, OS/2, all Windows NT systems on INTEL and ALPHA network platforms.

The main features of WAVEMON are:

- On-screen autonomy time/battery time countdown.
- On-screen server log-off and shutdown procedure.
- Time and date stamp event log.
- Extensive logging of all UPS activity and power quality data.
- Permits alarm warnings to be monitored remotely via email.

- Scheduled UPS service mode and other systems status.
- Graphical user interface for Windows-compatible platforms.
- Automatic unattended local shutdown.
- Special modules for MS-Office software to close and save open documents.
- Compatible with all optional modules like UPSDIALER, SNMP adaptors, temperature sensors, etc.

Functional description

WAVEMON is a client/server software application for networks and local workstations. In general, it consists of two parts: the server module of the UPS management software is *UPSMAN* which communicates with the UPS via an RS232/USB interface. Running as a background application, *UPSMAN* collects and interprets the messages received from the UPS and places them at the disposal of the client module *UPSMON,* as well as any connected SNMP-based instrumentation and control system.

If *UPSMAN* detects voltage variations or a power failure, it can execute various 'system event' routines, by means of which, for example, the server is switched off or a warning is sent to the connected users. These 'system event' routines are a part of the management software and can be configured in accordance with local application requirements.

The software of your PowerWave 9000 UPS unit can be integrated into a network in two ways:

1. By the server which is supplied by the UPS itself and has been integrated into the network. In most cases this server is used as a sub-agent and you only need the WAVEMON software (without an SNMP adapter). You will also need to establish an RS232/USB connection between the UPS and computer/server.
2. In many cases the use of what is referred to as an 'SNMP adapter' is to be preferred in order to integrate the UPS into the network. In this case up to 50 computers can be shut down in one RCCMD environment. RCCMD (remote console command) is an additional software module that is used in order to execute a command (typically a shutdown command) in a remote system.

Licensing

A licence is issued with every software serial number for use of what is known as the 'UPS service' on a single server in connection with one UPS and an unlimited number of connected WINDOWS workstations. For operation with two or more servers, a further licence is required for each additional server. In this case it is of no importance whether the UPS service on these servers is active or whether the server was stopped by a remote UPS service. The same applies to the use of RCCMD with the 'remote send/receive' modules for 'multi-server shutdown' under NT, UNIX and other operating systems.

The service programs are generally supplied as single licences. In order to use a single CD-ROM for several 'multi-server shut-down' units you must acquire additional licence codes.

RCCMD Server shutdown

In order that remote shutdown of servers can take place, initiated by the SNMP card or WAVEMON software, further licenses must be purchased. The license s for the RCCMD client (or listening) software that resides in each target server.

Note: *Virtual servers may not need a license per virtual server client. Please contact Technical Support to discuss you requirements.*

7.6.3 PowerREPORTER™ management software

PowerREPORTER™ is a remote monitoring and management service which is a part of the 'premium power protection concept'.

ThePowerREPORTER™ application:

- Provides affordable, continuous monitoring over mission-critical facilities and offers peace of mind by detecting and warning of any potential system problems before they become a crisis.
- Acquires key performance parameters and productivity information in real-time to enable you to better understand machine performance and faster troubleshoot downtime events
- Gives total transparent information concerning all actions performed on the system, such as all critical status changes, coordination of equipment service, reporting of all alarms with priorities

Key features

- Redundant and secure communication
- Alarm acknowledgment
- Priority driven Management (with escalation)

Comprehensive management system

- Reception and management of alarm calls from Uninterruptible Power Supplies Ltd
- Storage of UPS data in a database exportable in a CSV-format for easy handling in Excel
- Unlimited number of UPS that can be managed
- User administration with passwords and permission-level
- Administration of Log file
- Data logging with statistical analysis and diagnostics, report
- Visualization of the UPS data
  – Current status
  – Measured values for single or three phase
  – Recording function including graphs with zooming capabilities for selected measured values
  – Display of event log file
  – Display of UPS parameters
  – Web server functionality, for data access from any web browser

PowerREPORTER™ management software

PowerREPORTER is a remote monitoring and management service which provides peace-of-mind protection by offering a continuous (24/7/365) watch over mission-critical facilities. Continuous monitoring is an affordable insurance policy to detect issues and provide an early warning before they develop into a crisis.

The main features and benefits offered by PowerREPORTER are:

- Real time email notification sent directly to UPSL Service Centre in response to alarm/critical events.
- Acquisition of key performance data and productivity information. Empowers you with the details needed to better understand machine performance and quickly troubleshoot downtime events.
- Combined with a service contract, PowerREPORTER improves service levels. The engineer can determine if site attendance is necessary and bring relevant spare parts.
- Monthly Status Report detailing trends and alarms.
- Optional battery analysis and care service; PowerNSURE - measures battery voltage, temperature, impedance and prolongs battery service life through the application of battery charge equalization.

Functional description

PowerREPORTER communicates constantly with your UPS system in order to automatically detect any error or alarm messages. In the event of an incident being detected, PowerREPORTER automatically connects with UPSL's Service Centre via an email, transmitting a status message.

The email, which provides details relating to the fault, a snapshot of the UPS performance parameters and a device identification string, is automatically processed and UPSL's Service Centre personnel are alerted.

UPSL's Service Centre personnel are then able to liaise with the company's field service team and will remotely diagnose the UPS incident before reaching the facility with appropriate spare parts within the contracted service agreement time-frame.

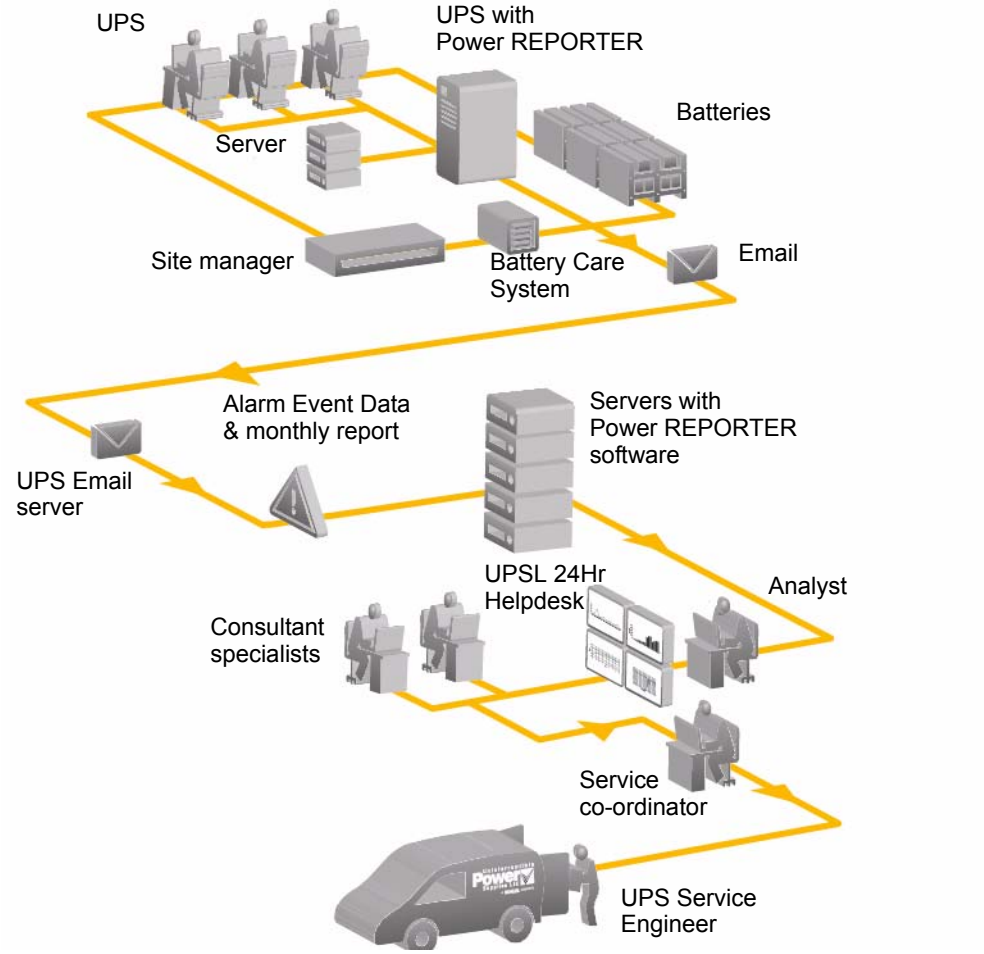


Figure 7.9 PowerREPORTER operation

•

8 Specifications

8.1 Mechanical Characteristics

		CLASSIC DPA-50	TRIPLE DPA-150	UPGRADE DPA-250
Capacity	Max.	1 module (30-45kVA) 280 x 7/9Ah batteries	3 modules (30-45kVA) 240x 7/9Ah batteries	5 modules (30-45kVA) no batteries
Max. Power connection	kVA	50	150	250
Dimensions (WxHxD)	mm	730x1650x800	730x1975x800	730x1975x800
Weight of Empty Cabinet	kg	250	270	190
Weight of Cabinet with modules and no batteries	kg	300 - 310 (with 1 Module)	420 - 450 (with 3 Modules)	440 - 490 (with 5 Modules)
Colours		Front: RAL 9007 + black (inlets). Sidewalls: Graffito grey		

PowerWAVE DPA MODULES		DPA 30	DPA 40	DPA 50
Output Apparent Power	KVA	30	40	45*
Output Active Power	KW	24	32	40
Output Power (PF=1)	KVA / KW	24 / 24	32 / 32	40 /40
Number of 12V Battery Blocks	No.	40-50	40-50	40-50
Dimensions (WxHxD)	mm	663 x 225 x 720		
Weight UPS Module	kg	50	57	60
Colours		Front: RAL 9007		
* On Inverter mode 50 KVA/40kW on Bypass mode 45 KVA/40kW				

8.2 Input Characteristics

Module Type		DPA 30	DPA 40	DPA 50
Output Rated Power per Module cosΦ 0.8	kVA	30	40	45[1]
Output Rated Power per Module cosΦ 1.0	KW	24	32	40
Nominal Input Voltage	V	3x380/220V+N, 3x400V/230V+N, 3x415/240V+N		
Input Voltage Tolerance (ref to 3x400/230V) for Loads in %:	V	(-23%/+15%) 3x308/177 V to 3x460/264 V for <100 % load (-30%/+15%) 3x280/161 V to 3x460/264 V for < 80 % load (-40%/+15%) 3x240/138 V to 3x460/264 V for < 60 % load		
Input Frequency	Hz	35 - 70		
Input Power Factor		PF=0.99 @ 100 % load		
Inrush Current	A	limited by soft start / max. In		
Input Distortion THDI		Sine-wave THDi = < 2 % @ 100% load		
Max. Input Power with rated output power and charged battery per Module (output CosΦ = 1.0)	kW	25.4	33.9	42.9
Max. Input Current with rated output power and charged battery per Module (output CosΦ = 1.0)	A	36.8	49.1	62.1
Max. Input Power with rated output power and discharged battery per Module (output CosΦ = 1.0)	kW	27.8	37.1	46.9
Max. Input Current with rated output power and discharged battery per Module (output CosΦ = 1.0)	A	40.3	53.7	68.0
1) On Inverter mode 50 KVA/40kW on Bypass mode 45 KVA/40kW				

8.3 Battery

Module Type		DPA 30	DPA 40	DPA 50
Variable Number of 12V Battery Blocks	No.	40-50	40-50	40-50
Maximum Battery Charger Current	A	10A Standard (15 A optional)		
Battery Charging Curve		Ripple free; IU (DIN 41773)		
Temperature compensation		Standard (temp. sensor optional)		
Battery Test		Automatic and periodically (adjustable)		
Battery Type		Maintenance free VRLA or NiCd		

8.4 Output

Module Type		DPA 30	DPA 40	DPA 50
Output Rated Power per Module	kVA	30	40	45 1)
Output Rated Power per Module	KW	24	32	40
Output Current In @ cosΦ 1.0 (400 V)	A	35	46.5	58
Output Rated Voltage	V	3x380/220V or 3x400/230V or 3x415/240V		
Output Voltage Stability	%	Static: < +/- 1% Dynamic (Step load 0%-100% or 100%-0%) < +/- 4%		
Output Voltage Distortion	%	With Linear Load < +/- 2% With Non-linear Load (EN62040-3:2001) < +/- 4%		
Output Frequency	Hz	50 Hz or 60 Hz		
Output Frequency Tolerance	%	Synchronized with mains < +/- 2 % (selectable) or < +/- 4 % Free running +/- 0.1 %		
Bypass operation		At Nominal Input voltage of 3x400 V +/- 15 % or 190 V to 264 V ph-N		
Permissible Unbalanced Load (All 3 phases regulated independently)	%	100%		
Phase Angle Tolerance (With 100 % Unbalanced load)	Deg.	+/- 0 deg.		
Overload Capability on Inverter	%	125 % load 10 min. 150 % load 60 sec.		
Output short capability (RMS)	A	Inverter: 2 x In during 250 ms Bypass: 10 x In during 10 ms		
Crest - Factor		3 : 1		
1) On Inverter mode 50 KVA/40kW on Bypass mode 45 KVA/40kW				

8.5 Environmental

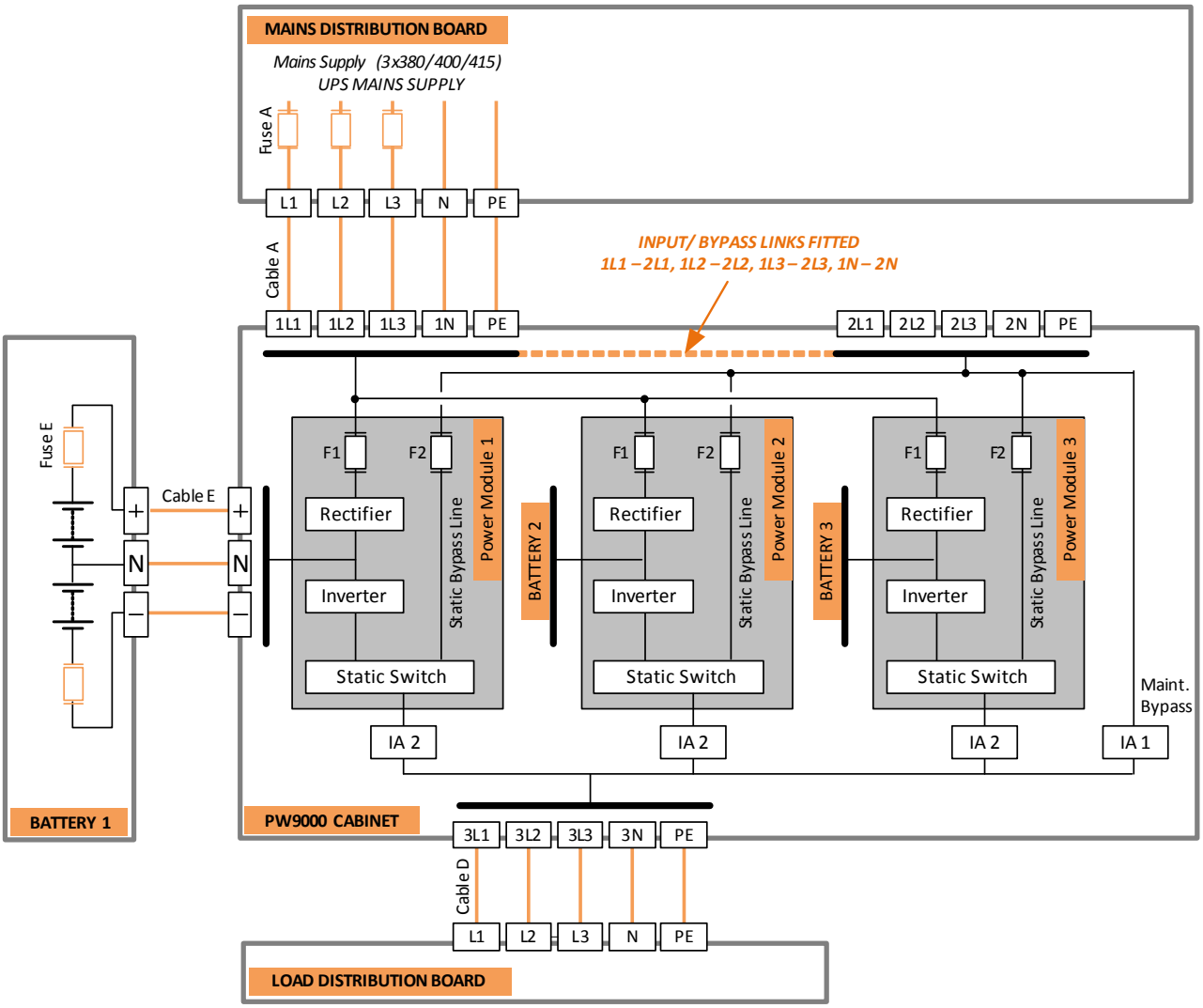
Module Type		DPA 30	DPA 40	DPA 50
Audible Noise with 100% / 50% Load	dBA	59/51	65/55	65/55
Operation temperature	°C	0 - 40		
Ambient Temperature for Batteries	°C	20 - 25 (recommended)		
Storage Temperature	°C	-25 - +70		
Battery Storage Time at Ambient Temperature		Max. 6 months		
Max. altitude (above sea level)	m	1000m (3300ft) without de-rating		
De-rating factor for use at altitudes greater than 1000m above sea level (IEC 62040-3)		0.9 @ 1500m / 4850ft asl		
		0.91 @ 2000m / 6600ft asl		
		0.86 @ 2500m / 8250ft asl		
		0.82 @ 3000m / 9900ft asl		
Relative Air-humidity		Max. 95% (non-condensing)		
Accessibility		Totally front accessibility for service and maintenance (no need for side, top or rear access)		
Positioning		Min. 20 cm rear space (required for fan)		
Input and Output Power Cabling		From the bottom on the front		

Efficiency AC-AC up to (pf = 1.0) (depending on Module power)	%	Load : 100 % 75 % 50% 25% Efficiency : 94.5% 94.5% 94% 93%		
Efficiency Linear Load at pf = 0.8ind Efficiency Non-linear Load (EN 62040-1-1:2003)		Typically up to 1 % higher of above values Typically up to 1 % lower of above values		
Eco-Mode efficiency at 100% load	%	98 %		
Heat Dissipation with 100% Non-linear Load per Module (EN 62040-1-1:2003)	W	1670	2225	2780
Heat Dissipation with 100% Non-linear Load per Module (EN 62040-1-1:2003)	BTU	5698	7592	9485
Airflow (25° - 30°C) with Non-linear Load per Module (EN 62040-1-1:2003)	m^3/h	380	380	380

8.6 Packed weights

UPS	Power Modules	Packed Weight (Kg)			Packed Dimension mm	Unpacked Weight			Unpacked Dimension mm
		DPA 10 or 15 no Batt.	DPA 20 or 25 no Batt.			DPA 10 or 15 no Batt.	DPA 20 or 25 no Batt.		
DPA-50	1	360	367	370	880x1825x915	300	307	310	730x1650x800
DPA-150	1	TBA	TBA	TBA	880x2150x915	TBA	TBA	TBA	730x1975x800
	2	TBA	TBA	TBA	880x2150x915	TBA	TBA	TBA	730x1975x800
	3	TBA	TBA	TBA	880x2150x915	TBA	TBA	TBA	730x1975x800
DPA-250	1	300	307	310	880x2150x915	240	247	250	730x1975x800
	2	350	364	370	880x2150x915	290	304	310	730x1975x800
	3	400	421	430	880x2150x915	340	361	370	730x1975x800
	4	450	478	490	880x2150x915	390	418	430	730x1975x800
	5	500	535	550	880x2150x915	440	475	490	730x1975x800

8.7 Cable and fuse sizing (Single feed input)

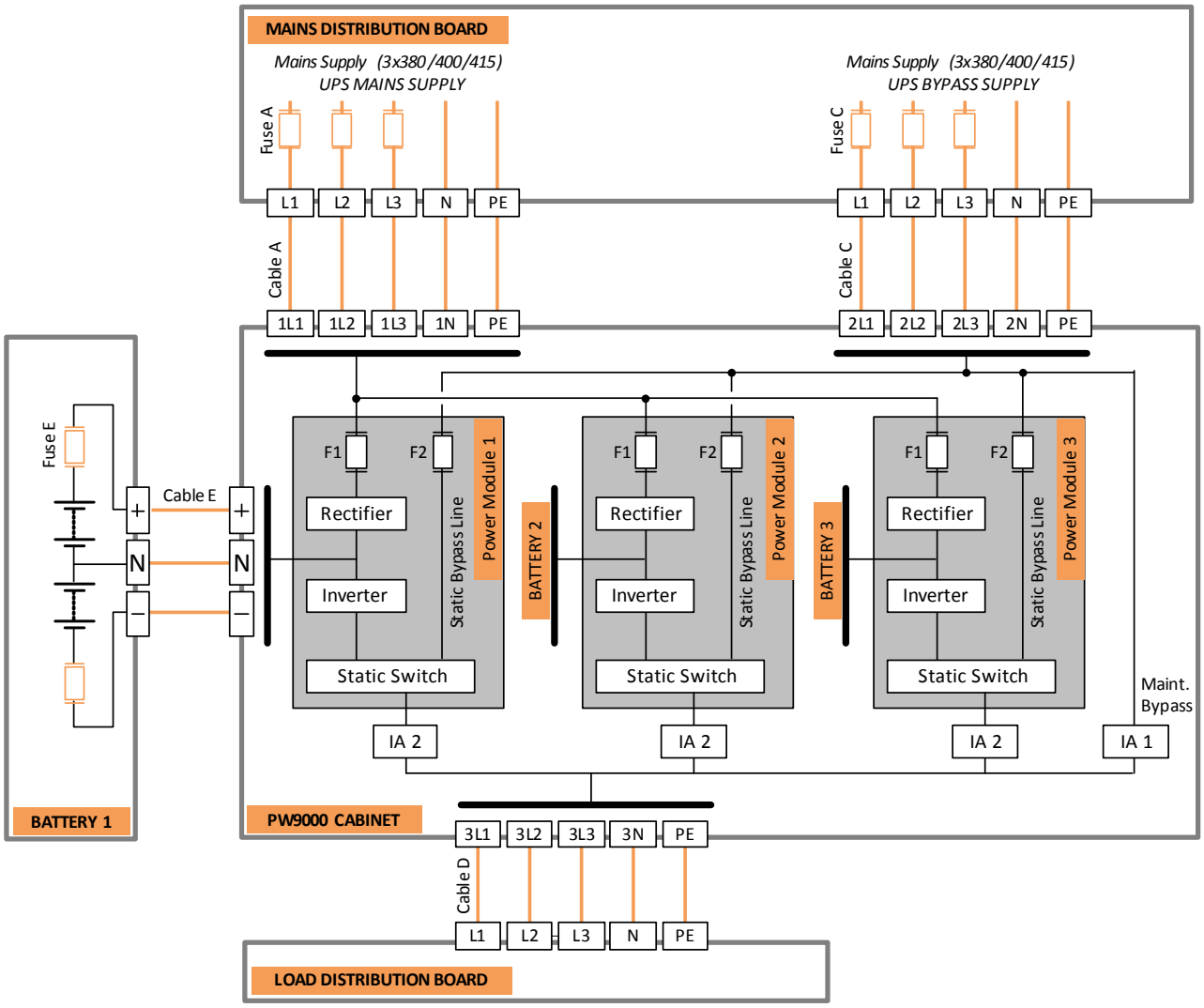


Cabinet (Frame)	Power (kVA)	Single Input (3 x 400V)			Output (3x400V, 0.8 pf)	
		Fuse A (A)	Cable A (mm^2)	Max Input with batt charging (A)	Cable D (mm^2)	Nominal Current (A)
DPA-50	50	3x100	5x25	67	5x25	72
DPA-150	150	3x250	5x120 or 5x(2x50)	202	5x120 or 5x(2x50)	218
DPA-250	250	3x400	5x(2x95)	337	5x(2x95)	362

Notes:

1. Fuse and Cable recommendations to IEC 60950-1:2001
2. The fuse and cable rating details in the above tables are a recommendation only.
3. The UPS must be installed to prescribed IEC or local regulations (e.g. BS7671:2008).
4. DC Cables and Battery fuses are bespoke to the installation.

8.8 Cable and fuse sizing (Dual feed input)



Cabinet (Frame)	Power (kVA)	Dual Input (3 x 400V)				Output (3x400V, 0.8 pf)	
		Fuse B/C (A)	Cable B (mm^2)	Cable C (mm^2)	Max Input (A) with battery charging	Cable D (mm^2)	Nominal Current (A)
DPA-50	80	3x100	5x25	4x25	67	5x25	72
DPA-150	150	3x250	5x120 or 5x(2x50)	4x120 or 4x(2x50)	202	5x120 or 5x(2x50)	218
DPA-250	250	3x400	5x(2x95)	4x(2x95)	337	5x(2x95)	362

Notes:

1. Fuse and Cable recommendations to IEC 60950-1:2001
2. The fuse and cable rating details in the above tables are a recommendation only.
3. The UPS must be installed to prescribed IEC or local regulations (e.g. BS7671:2008).
4. DC Cables and Battery fuses are bespoke to the installation.